96-138

BUILDING ENERGY PERFORMANCE STANDARDS IMPLEMENTATION ACT OF 1980

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ENERGY REGULATION

OF THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

NINETY-SIXTH CONGRESS

SECOND SESSION

ON THE

STATUS AND ISSUES ASSOCIATED WITH THE BUILDING ENERGY PERFORMANCE STANDARDS PROGRAM

AND

S. 2862

A BILL TO AMEND THE ENERGY CONSERVATION AND PRODUCTION ACT TO PROVIDE FOR A REALISTIC SCHEDULE FOR THE PROMULGATION AND IMPLEMENTATION OF ENERGY EFFICIENCY PERFORMANCE STANDARDS FOR NEW COMMERCIAL AND RESIDENTIAL BUILDINGS, AND FOR OTHER PURPOSES

JUNE 5 AND 26, 1980

Publication No. 96–138

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BUILDING ENERGY PEFORMANCE STANDARDS IMPLEMENTATION ACT OF 1980

THURSDAY, JUNE 5, 1980

U.S. SENATE,
SUBCOMMITTEE ON ENERGY REGULATION,
OF THE COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 3110, Dirksen Office Building, Hon. J. Bennett Johnston, presiding.

Present: Senators Johnston, Bumpers, Ford, and Domenici.

Also present: Benjamin S. Cooper, professional staff member; James T. Bruce, counsel; and Gary Barbour, professional staff member for the minority.

OPENING STATEMENT OF HON. J. BENNETT JOHNSTON, A U.S. SENATOR FROM THE STATE OF LOUISIANA

Senator JOHNSTON. The hearing will come to order.

The building energy performance standards, BEPS, program which was initiated in August 1976 with the passage of the Energy Conservation and Production Act, ECPA, is currently scheduled for congressional review later this year. The purpose of our hearing today is to bring the committee up to date on the status of the program and the issues associated with it.

It is evident that there are several issues of interest. The subcommittee has received numerous requests to appear at the hearing from organizations with both favorable and unfavorable attitudes toward the program. These attitudes are represented on our witness list today in order to stimulate a full discussion of the issues.

As we understand the current schedule of the Department of Energy, a final rule, based on the proposed rule published in the Federal Register on November 28, 1979, will be promulgated sometime in August 1980. ECPA provides that upon promulgation of the final rule establishing standards for new residential and commercial buildings, a 90-day period of congressional review commences during which Congress is to consider whether or not a particular sanction set forth in the act is to be approved to make the standard mandatory.

This review process cannot be completed in the 97th Congress. The Congress is almost certain to adjourn sine die before the end of any 90-day period which begins in August. If this happens, congressional consideration of the sanctions issue will automatically be postponed until the beginning of the 97th Congress.

Perhaps in recognition of this fact, the Banking, Housing, and Urban Affairs Committees of the House and Senate have reported legislation formally extending the deadline for final promulgation of the standard until August 1982.

Although there is opposition to any delay in the promulgation of a final standard, and we will hear the arguments against delay later this morning, it seems likely that a delay will occur.

If that is the case, I believe this hearing can provide a valuable forum to discuss the way in which the additional time should be used so as to provide the Nation with a workable energy efficiency standard for new building construction.

We have an outstanding panel this morning. It is a fairly small panel. If we had put on the panel today all of those even really outstanding groups that wanted to testify, many of them my good friends we would have a line of people with about 3 minutes each today to testify, and we just wouldn't get the substance of the matter, so we are going to try to have another day's hearings. I think we do have another scheduled. We don't have a commitment on another day's hearings, but we are going to try to do it so that so many of these very important groups will be able to be heard.

Today we have a fairly small list but a really outstanding list. We begin with Dr. Maxine Savitz, Deputy Assistant Secretary for Conservation of the Department of Energy, and Dr. Savitz is accompanied by her assistants.

Glad to have you, Doctor.

STATEMENT OF DR. MAXINE SAVITZ, DEPUTY ASSISTANT SECRETARY FOR CONSERVATION, DEPARTMENT OF ENERGY, ACCOMPANIED BY JOHN MILLHONE, OFFICE OF BUILDINGS AND COMMUNITY SYSTEMS; AND RICHARD KESSLER, OFFICE OF GENERAL COUNSEL

Dr. Savitz. Thank you, Senator Johnston. We are pleased to be here. I want to introduce my colleagues. I am accompanied by Mr. John Millhone on my right who heads the Office of Buildings and Community Systems under which the BEPS program is being developed, and prior to coming to the Department of Energy about 15 months ago Mr. Millhone had been head of the Minnesota Energy Agency which had one of the earliest building codes for energy conservation.

On my left is Mr. Richard Kessler from the Office of General Counsel.

My testimony today will explain the status of the Department of Energy's proposed building energy performance standards and our plans for going forward with the program. Since it is fairly short, I would like to go through most of it in detail.

On November 28, 1979, DOE published a Notice of Proposed Rulemaking in the Federal Register. The close of the comment period was on April 30. There was an enormous amount of interest at that point, just as you expressed in your hearings also. During this period 8,300 Notices of Proposed Rulemaking and 20,000 technical supporting documents were mailed to members of the public at their request. We recently completed 19 days of public hearings in 6 cities around the country; 430 witnesses testified. We also received 739 comments in writing and over 4,000 calls on a hotline that we had set up.

The hearing testimony and comments together total over 14,000 pages of text which we are reviewing and analyzing. We were very grateful for the serious, thoughtful, and constructive nature of the testimony and comments. By responding effectively to these comments, we think we will have a better program.

These comments came from various groups of organizations—the building industry, representatives from energy supply, representatives of public interest groups, environmental groups, Government representatives, and other interested parties.

There were several issues that were consistent throughout the hearings and I will summarize some of those. One of those that generated widespread concern was the proposed weighting factors for the type of fuel used. Many people, particularly representatives of the electric power industry, opposed them, while some groups such as the gas industry favored them.

Many witnesses objected to aspects of the proposed standard evaluation technique and the lack of existing alternatives to the DOE-2 computer program which is used in the standards to estimate building energy consumption from a set of design drawings.

The method for setting the design energy budget was questioned by many witnesses. There was controversy over the number and types of building categories. A number of witnesses felt that the energy budget levels didn't adequately reflect local weather conditions. The majority felt BEPS would be more costly than DOE's estimates. Some architects, most public interest groups, solar groups, and private citizens, favored rapid implementation of the more stringent mandatory standard. Most other groups, particularly the homebuilders, favored a slower pace to include pilot testing on a voluntary basis.

Despite these reservations, the vast majority of the witnesses expressed strong support for more energy efficient buildings and a willingness to work with us to help find a way to make the proposed standards work.

In response to these comments, we have developed a plan for going forward with the BEPS which we feel will lead to an effective performance standards program. We believe the plan is also responsive to strong indications by Congress that some additional time be taken to improve the proposed rulemaking.

As you mentioned, the Banking Committee in both the Senate and the House have approved the 2 year extension in the promulgation of the final standards as an amendment to the HUD fiscal year 1981 authorization bill.

The elements of our plans for going forward are as follows. First, instead of issuing a final standard this August, we intend to repropose the standard as soon as possible but no later than February of 1981. We will conduct a new round of hearings and plan to issue the final standard as soon as possible thereafter, but no later than August 1981.

The revised schedule should allow us to respond to many of the issues that I mentioned which were raised at the public hearing.

The objective of DOE is to make the reproposal an integrated package of all the major elements in the program. These elements include in addition to a reproposal of the standards an initial Notice of Proposed Rulemaking on the implementation of the standards, an integrated draft environmental impact statement that will deal with the standards and the implementation, a draft component performance standard similar to that developed by ASHRAE that would be equivalent to BEPS, a timetable to revise the minimum property standards which is used in the Federal housing programs, a cookbook guide for complying with BEPS which will be a draft residential manual of recommended practices for determining that State and local building codes are equivalent, procedures to certify whether computer and other calculation techniques are equivalent to the standard evaluation technique, and the addition of mobile homes.

The second part is that we would extend and use DOE's existing authority under the State energy conservation program or the Energy Management Partnership Act to broaden the coverage and increase the effectiveness of energy efficiency provisions in the State building codes.

Since the initiation of the State energy conservation program in 1976, many States have made progress toward the enactment of energy codes. The number of States with some type of energy code has increased from 2 to 44. DOE may use its authority to withhold funds to encourage the remaining States to enact codes, to increase the coverage of existing codes to additional building categories, and to improve the effectiveness of this process.

We will encourage States with codes in place to revise them to be in conformance with BEPS once final standards are promulgated. In many States this can be done just by regulation and won't require new State legislation. We will be able to see whether this existing machinery can be used effectively.

Third, we are planning a program of field testing of the BEPS program which would include pilot programs in States that want to show leadership and innovation in meeting the BEPS standards, a demonstration of buildings that meet or exceed the standards and use the various implementation methods.

In 1981 we would also begin research on items that are not in the current BEPS proposed rule such as restaurants and heavy industrial buildings.

Fourth, the Department intends to communicate and interact more effectively with groups that have offered to help us develop the BEPS program. The National Institute of Building Science, NIBS, is working with us to develop such a plan. We want to bring the entire building community into this process, including those who design, build, and finance new structures.

DOE also intends to make a special effort consistent with regulatory requirements to seek the advice of consumer, conservation, and environmental groups who participated in the BEPS hearing.

Fifth, with the promulgation of the final standards, we will make a recommendation to Congress on the implementation of the BEPS program. Several possibilities are being considered. These include the use of sanctions, subject to congressional approval, as in the current law.

They also include other possible mandatory and voluntary approaches as well as the use of the existing programs under the State conservation program.

We are currently leaning toward the use of existing programs which rely on State and local code programs, along with the expanded information, education and demonstration program.

However, a recommendation to Congress that would include sanctions has not been abandoned. Some form of sanctions may be the appropriate course if the energy supply situation deteriorates or if there has been inadequate progress toward energy efficiency in new buildings.

Careful consideration will be given to changes being made by the building industry in response to higher energy prices. Data on current trends in building energy efficiency is sparse, but there is evidence of progress as well as delays in improving new building energy designs.

The sixth action DOE intends to do is to achieve a maximum return on the resources that it is authorized for this program. We currently have 10 authorized positions with the BEPS program. Only seven of these have been filled prior to the current personnel freeze. Since that time, four of the seven have resigned, leaving a staff of only three. We have already determined that the seven existing vacancies can be filled immediately under the ground rules of the hiring freeze.

After they are filled, we will reassess the total staff requirements.

In addition to support for the BEPS plan outlined above, there is one additional congressional action that is needed. It is a transfer of the BEPS implementation authority from HUD to DOE. The administration, particularly both HUD and DOE, have requested Congress to transfer authority for implementation of BEPS from HUD to DOE. We wish to express our appreciation to the Senate Committee on Banking, Housing, and Urban Affairs for favorably reporting out this requested transfer as part of their fiscal year 1981 authorization budget.

Since the inception of the BEPS program, many Members of Congress as well as those groups most directly affected by the BEPS regulations have requested DOE to deal concurrently with the twin issues of development of standards and their implementation.

Members of the public can hardly be expected to understand BEPS if they are only informed about the standards but not how they will be carried out. By consolidating authority within DOE, Congress will make it possible for DOE to treat BEPS as one integrated program and no longer a program that is unnaturally split in two.

The building energy performance standards will be as important and worthwhile as those who drafted and approved the law expected they would be. They encourage new technology, new design practices, and they provide a central focus for public and private efforts to insure that all new residential and commercial buildings are far more efficient than those built in the past.

The plan presented today sets forth a direction and a schedule for accomplishing these important objectives. We appreciate the opportunity to be here today, and we will be happy to try to answer your questions.

[The prepared statement of Dr. Savitz follows:]

STATEMENT OF

MAXINE SAVITZ

DEPUTY ASSISTANT SECRETARY FOR CONSERVATION

U.S. DEPARTMENT OF ENERGY

BEFORE THE

SENATE COMMITTEE ON ENERGY AND NATIONAL RESOURCES

SUBCOMMITTEE ON ENERGY REGULATION

JUNE 5, 1980

My testimony today is to explain the status of the Department of Energy's proposed Building Energy Performance Standards (BEPS) and our plans for going forward with the program.

On November 28, 1979, DOE published a Notice of Proposed Rulemaking on BEPS in the Federal Register. The close of the comment period was on April 30. An enormous amount of interest has been shown toward BEPS. During this period, 8,300 Notices of Proposed Rulemaking and 20,500 Technical supporting Documents were mailed to members of the public at their request. We recently completed 19 days of public hearings on this Notice in six cities around the United States. During these hearings, 430 witnesses testified. DOE received 739 comments and 4,150 calls on our BEPS hotline. Hearing testimony and comments together total 14,000 pages of text.

DOE is extremely grateful for the serious, thoughtful, and constructive nature of the testimony and comments. By responding effectively to these comments, we will have a better BEPS program.

The types of organizations represented by the speakers at the hearings included building industry representatives, 229 witnesses; energy supply representatives, 90 witnesses; public interest groups, 38 witnesses; government representatives, 40 witnesses; and other interested parties, 33.

One of the issues that generated widespread concern was the proposed weighting factors for the types of fuels used. Many people, particularly representatives of the electric power industry, opposed them while some groups, such as the gas industry, favored them.

Many witnesses objected to aspects of the proposed Standard Evaluation Technique and the lack of existing alternatives to the DOE-2 computer program which is used in the Standards to estimate building energy consumption from a set of design drawings. The method for setting the Design Energy Budget was questioned by many witnesses. There was controversey over the number and types of building categories. A number of witnesses felt the energy budget levels didn't adequately reflect local weather conditions. The majority felt BEPS would be more costly than the DOE's estimates. Some architects, most public interest groups, solar groups and private citizens favored rapid implementation of a more stringent mandatory standard. Most other groups, particularly home builders, favored a slower pace to include pilot testing on a voluntary basis.

Despite these reservations, the vast majority of the witnesses expressed strong support for more energy-efficient buildings and a willingness to work with DOE to help find a way to make the proposed standards work.

In response to these comments, DOE has developed a plan for going forward with BEPS which we feel will lead to an effective performance standards program. We believe the plan is also responsive to the strong indications by Congress that some additional time be taken to improve the proposed rulemaking. As you know, the Banking Committees in both the Senate and House have approved a 2-year extension in the promulgation of the final standards, as an amendment to the HUD FY 1981 Authorization Bill.

The elements of our BEPS plan are as follows:

First, instead of issuing a final Standard this August, we intend to repropose the Standard as soon as possible but no later than February 1981, to conduct a new round of hearings, and to issue a final Standard as soon as possible thereafter but no later than August 1981.

The revised schedule should allow us to respond to most of the major issues raised in the public hearings.

The objective of DOE is to make the reproposal an integrated package of all the major elements in the BEPS program. The major elements of the BEPS rogram which DOE is planning to issue by no later than February include:

- o A reproposal of the Standards.
- o An initial Notice of Proposed Rulemaking on the implementation of the Standards.
- o An integrated draft Environmental Impact Statement dealing with both the Standards and implementation.
- o A draft component performance Standard similar to the conservation standards already developed by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) that has been upgraded to be the equivalent to BEPS.
- o A timetable to revise the Minimum Property Standards, used in Federal Housing Programs to be equivalent to BEPS.
- o A draft residential Manual of Recommended Practices to provide a "cookbook-style" guide for complying with BEPS.
- o A process for determining that State and local building codes are equivalent to BEPS.
- o A procedure for certifying whether computer and other calculation techniques are equivalent to the Standard Evaluation Technique.
- o The addition of mobile homes to the building classifications covered initially by the Standards.

Second, DOE intends to use its existing authority under the State nergy Conservation Program or the Energy Management Partnership Act, if pproved by Congress, to broaden the coverage and increase the effectiveness f energy-efficiency provisions in the State and local building codes. ince the initiation of the State Energy Conservation Program in 1976, the

States have made impressive progress toward the enactment of energy codes as required by the implementing regulations. The number of States with some type of energy codes has increased from two to 44. DOE may use its authority to withhold funds to encourage the remaining States to enact codes, to increase the coverage of existing codes to additional building categories where appropriate, and to improve the effectiveness of the codes enforcement process.

DOE will encourage States with codes in place to revise them to be in conformance with BEPS once the final Standards are promulgated. In many States, this can be done through a revision in the State code by regulation, without requiring new State legislation. DOE will be able to see whether this existing machinery can be used effectively to implement the BEPS program.

Third, DOE is planning a program of field testing the BEPS program. This plan will include pilot programs in States that want to show leadership and innovation in meeting the BEPS Standard; a demonstration of buildings that meet or exceed the Standard; the testing of different implementation techniques, including simplified implementation tools; and the provision of seed money for consumer education and the training of design professionals, code officials and home builders. Also in FY 1981, we plan to begin the research items necessary for the second generation of BEPS, including research on restaurants and heavy industrial buildings.

Fourth, DOE intends to communicate and interact more effectively with the groups that have offered to help us in developing the BEPS program. The National Institute of Building Science (NIBS) is working with DOE to develop a plan for such interaction. The objective will be to bring the building community at large, including those who design, build, buy and use buildings, into this communication process. DOE also intends to make a special effort, consistent with regulatory requirements, to seek the advice of the consumer, conservation and environmental groups who participated actively in the BEPS hearings.

Fifth, with the promulgation of the final Standards the Administration intends to make a recommendation to Congress on the implementation of the BEPS program. There are several possibilities currently being considered. These include the use of sanctions, subject to congressional approval, as provided in the Energy Conservation Standards for New Buildings Act of 1976. They also include other possible mandatory and voluntary approaches, as well as the use of the existing program of State grants under the State Energy Conservation Program or the Energy Management Partnership Act, its proposed successor.

DOE currently is leaning toward the use of the existing program which relies on State and local code programs, along with an expanded information, education and demonstration program. However, a recommendation to Congress on the possible use of sanctions hasn't been abandoned. Such sanctions may be the appropriate course if the energy supply situation deteriorates or if there has been inadequate progress toward energy efficiency in new buildings. Careful consideration will be given to the adjustments being made by the building's industry to higher energy prices. Data on current trends in new building energy efficiency is sparse, there is some evidence of progress as well as delays in improving conventional building practices.

Sixth, DOE intends to achieve a maximum return on the resources it is authorized for this important program. DOE currently has ten authorized positions for the BEPS program. Only seven of those positions had been filled prior to the current personnel freeze. Since then, four of the seven have resigned leaving a current BEPS staff of only three. DOE has already determined that the seven existing vacancies can be filled immediately under the ground rules of the hiring freeze.

In addition to support for the BEPS plan outlined aboved, there is one additional congressional action that is needed. It is the transfer of the BEPS implementation authority from HUD to DOE. The Administration, in particular both HUD and DOE, have requested Congress to transfer authority for implementation of BEPS from HUD to DOE. DOE and HUD wish to express their appreciation to the Senate Committee on Banking, Housing, and Urban Affairs for favorably reporting out this requested transfer last month as part of the HUD FY 1981 Authorization Bill.

Since the inception of the BEPS program, many Members of Congress, as well as those groups most directly affected by the BEPS regulations, have requested DOE to deal concurrently with the twin issues of development of the Standards and their implementation. Members of the public can hardly be expected to understand BEPS if they are only informed about the energy standards for new construction but not how they will be carried out. By consolidating authority within DOE, Congress will make it possible for DOE to treat BEPS as one integrated program and no longer a program that is unnaturally split in two.

The Building Energy Performance Standards will be as important and worthwhile as those who drafted and approved the law expected they would be. They encourage new technology, new design practices, and they provide a central focus for public and private efforts to ensure that new residential and commercial buildings are far more efficient than those built in the past. The plan presented today sets forth a direction and schedule for accomplishing these important objectives.

Thank you for the opportunity to be here today. I will be happy to answer any questions.

Senator JOHNSTON. Thank you very much, Dr. Savitz. I'm sorry to say I haven't studied these standards as closely as I will by the time we make a decision on this matter if it is presented to Congress rather than you using your existing authority. Would you walk through a specific example showing how a builder would calculate performance of his building relative to the proposed standards and tell me in particular how the weighting factors would enter the calculation?

Dr. SAVITZ. I will try to do two things and then Mr. Millhone may want to add to it. I can tell you if a number is promulgated, what the standard is is essentially a budget which is expressed in Btu's per square foot per year and then it is up to the builder, the architect, or engineer to design his building to meet that standard.

What I will do for a residential building is give you what the budget might be for a city and how it might be met and then also discuss the weighting factor we have proposed for 78 various climate areas. The budget is expressed as Btu per square foot. We can take as an example a building in Chicago, Ill.

Senator JOHNSTON. Let's look at, I am looking at page 68171 of the Federal Register, volume 44 dated November 28, 1979, and my finger just happens to hit Louisiana, Baton Rouge, and tell me how that works out.

[The page referred to contains the following table:]

Table 1-1: HEATING AND COOLING ENERGY BUDGET LEVELS FOR SINGLE-FAMILY RESIDENTIAL BUILDING DESIGNS (in MBtu/ sq. ft./ yr) (CONT'D)

State	SMSA	Single-Family Detached			Single-Family Attached		
		Gas	Oil	Electric	Gas	Oil	Electric
Florida	Tampa	28.6	28.7	30.9	24.5	24.7	24.0
Georgia	Atlanta	26.3	29.1	25.7	19.8	21.8	19.2
Idaho	Boise City	35.1	41.7	40.0	25.8	30.7	30.6
Illinois	Chicago	39.1	46.5	46.6	29.2	34.8	36.0
	Glenview	40.0	47.4	47.6	30.0	35.6	36.8
Indiana	Indianapolis	39.0	46.1	45.6	29.2	34.4	35.1
Kansas	Dodge City	26.3	32.9	32.8	37.9	44.1	42.8
Kentucky	Louisville	32.9	38.1	35.2	24.3	28.0	26.6
Louisiana	Baton Rouge	26.3	27.1	27.0	21.7	22.3	20.7
	Lake Charles	28.0	29.3	28.5	22.6	23.6	21.7
	New Orleans	27.9	29.3	28.3	22.4	23.5	21.5
Maine	Portland	44.6	54.3	46.8	34.6	42.2	46.6
Massachusetts	Boston	36.3	43.2	42.1	26.9	32.0	32.2
Michigan	Detroit	40.8	48.7	49.8	30.7	36.7	38.6
Minnesota	Minneapolis	56.9	68.3	80.2	45.4	54.6	64.0
Mississippi	Jackson	28.8	31.0	28.9	22.5	24.1	21.8
Missouri	Columbia	35.8	42.8	41.0	27.4	31.8	31.3
	Kansas City	37.5	43.3	41.5	28.0	32.3	31.7

Note: Cooling is assumed to be provided by electricity in all cases

Dr. SAVITZ. OK. That is the same page I turned to. It has for single-family houses, if you were to design a house using gas, you would have a budget of 26,300 Btu's per square foot per year you would have to meet. If it were an oil-heated house, it would be 27.1, and electric, 27.0, electric heated.

They are all assumed to be electric air-conditioning.

Senator JOHNSTON. Now you have let them use more oil than gas.

Dr. SAVITZ. They can use slightly more. Well, it is a slightly less tight standard for oil than gas, and that is where the weighting factors get into the basis of how much the price of fuel is, how much the cost of oil is, how much the cost of gas is, how much the price of gas is using EIA estimates for 1985 prices, and then we added a premium.

Senator JOHNSTON. It is based on prices?

Dr. SAVITZ. Based on prices.

Senator JOHNSTON. It is not based on scarcity or perceived need to save one or the other?

Dr. SAVITZ. In addition to the prices, we have added a premium for using oil or natural gas that would add $7.13 to the estimated 1985 price of a barrel of oil or a comparable amount of gas. These add-on numbers come from the Fuel Use Act, so instead of just taking a price that we have proposed for those three fuels or projected for those three fuels in 1985, we did assign a premium value to show that oil and gas might be more scarce.

Senator JOHNSTON. Electric, is that delivered space heat you are talking about?

Dr. SAVITZ. Yes. That represents the price of electricity.

Senator JOHNSTON. Isn't $27 worth of electric delivered space worth more than $27.1 of oil? I guess that's right.

Dr. SAVITZ. No. These numbers are not dollars. These numbers are thousands of Btu's, thousand Btu per square foot per year. The number is arrived at where we have taken what we call the weighted factor.

Senator JOHNSTON. What I am getting at is the 27.1, is that the energy in the oil or the energy delivered to the space?

Dr. SAVITZ. That is the energy that a house built using oil heating would be designed to consume. The energy would be used for the heating of that building and the cooling of that building.

Senator JOHNSTON. That you would consume in the house even though a lot more of the oil heat goes up the stack than electric heat?

Dr. SAVITZ. Well, the oil heat at the site is about 75-percent efficient. The electric at the house is about 100-percent efficient. When you look at the generation and transmission of electricity and the energy this requires, electricity is only about 30-percent efficient. Oil and natural gas are closer to 100 percent in the energy delivered from well to the building site.

Senator JOHNSTON. The oil to ground to house?

Dr. SAVITZ. Very little is lost in getting that oil to your house as far as amount of Btu's available to utilize the heat.

Senator JOHNSTON. So what?

Dr. SAVITZ. We have used weighting factors based on the price or different energy sources rather than the technical conversions.

Senator JOHNSTON. You have 27.1 and 27.0. That is the point. Why?

Dr. SAVITZ. These design energy budget numbers are based upon the estimated price in 1985 of oil, natural gas, and electricity plus the add-on to oil and gas prices based on the Fuel Use Act. The numbers simply show the results of these calculations.

Senator JOHNSTON. Is this a moving target all the time, these numbers?

Dr. SAVITZ. The numbers would need to be revised periodically as there are changes in estimated future energy costs. In addition one of the problems is that the weighting factors for electricity were based on national prices. We are looking at regional prices or local prices, and they would vary depending how your electricity is generated. If your electricity is generated by coal or hydro, it should be sort of a different weighting factor and different price than if it is generated by oil and gas. We have not done that yet. That is something that we have currently planned.

Senator JOHNSTON. Tell me the answer to this basic question. I remember when we were working on ECPA, as I recall I had a lot to do with this standard. That is my foggy memory back there, but what I had in mind at least when I was thinking about building energy performance standards, was the kind of standards that FHA has that says you have got to have, down in my country, a slab with so many inches of sand and so many inches of concrete, and you have got to have 4 inches as I recall of insulation in the ceiling. That is what I had in mind because it seemed to me that is something that builders could understand and where you would know what to do. This business of you have got to look at the chart which says 27.1 million Btu's per square foot per year, but the price changes, and you have got to put that through the computer—my question is really why can't you develop standards that say so many inches of this kind of insulation?

Dr. SAVITZ. The law requires us to promulgate a performance standard which says we should promulgate a performance standard and not define the methods, materials or processes or how you are going to get to it.

One of the things we are working on so people can make that transition from the performance standards to what you mentioned, like the HUD property standards, is make an equivalent prescriptive standard. We are currently working with HUD who is turning the number like 27,000 Btu's per square foot per year from a number into a prescription to meet that number, that in Baton Rouge, La., how much insulation you would need in your ceiling, in your walls, whether you would need single or double glazing, various solutions to it, so we are doing those equivalencies.

That was one of the problems at our public hearings. We have not completed the equivolent standards yet, and that is the work we plan to complete in the next 6 months.

In addition, we would develop some manuals of recommended practice. These would be design elements of a house or of a building that a builder could refer to. It would have been certified to be equal to the same amount of consumption of energy as the number, and then he could just use that design and meet the standard.

Senator JOHNSTON. It looks to me like you ought to have alternatives. You ought to have maybe one of these complicated ways to meet the standard so that if you want to get an architect that wants to innovate on these things, he could. He could say we are going to put dirt on the roof. I have read about those kinds of things, you know, or something innovative. He can do that, but for the ordinary guy who just wants to build a house-type house, he shouldn't have to go looking at something complicated.

Dr. SAVITZ. No, and that is our intent.

Senator JOHNSTON. Let me tell you what happened to me. I had a fire in my basement and it burned through the walls and we found out we didn't have any insulation in our basement—none.

Now there should be some simple standard that says if you are going to build a basement in Washington, D.C., you have to put in at least whatever the standard is, 4 inches or whatever, of equivalent kind of insulation, and you ought to have at least so many inches in the roof and then that way it is simple to understand. Everybody would know.

The more complicated it is it seems to me the more difficult it is to enforce.

Dr. SAVITZ. We feel the same way as you do, and that is why we are taking the next step and having these alternative approaches, so just the same thing you said, if somebody wanted to be innovative and wanted to, a builder wants to have an architect, he could go the performance route.

We would also provide the minimum property standards which exactly state how much, what R value of insulation, the type of glazing and that would be in compliance with the standard, and the third thing would be various designs and blueprints for buildings already there that a builder could take and use to meet the standards. Those are the type of things we plan to prepare in the next 6 months and offer them for comments to the public.

We also plan to work with the homebuilders, with the architects, with engineers as we develop it so that we have something that is appropriate and that they can use. We want to obtain their practical and professional input as we develop manuals of recommended practice.

Senator JOHNSTON. So you do plan to have two alternatives?

Dr. SAVITZ. Yes.

Senator JOHNSTON. Before you make it mandatory or seek to make it mandatory, you will have a simple way of doing it?

Dr. SAVITZ. That's right, and we would like to test some of that out at the same time. Let people see if it really does work before we make it mandatory.

Senator JOHNSTON. We can certainly make this work if we make it simple enough.

Dr. SAVITZ. Yes, and I think it is very important to make it work. We have a lot of energy that is potentially there to save.

Senator JOHNSTON. I don't want you to allow them to build any homes without insulation in the basement like mine. We wondered why it was cold.

Dr. SAVITZ. Take advantage of the tax credit and put it in.

Senator JOHNSTON. Don't you worry about that. Now tell me why you want to have these weighting factors for the different fuels. It looks to me like, first of all, it is very difficult to say which fuel ought to be weighted and how.

In effect you have penalized the use of electricity here or at least the Edison Electric Institute thinks you are. Much of our electricity is hopefully going to be generated by coal which is abundant, nuclear which is abundant, some of our gas of which there is a gas bubble now.

How do you figure all of that in and come up with this figure that says electricity should be discouraged?

Dr. SAVITZ. The approach to these weighting factors was based on price, and it really compares the price of the different fuel sources.

Senator JOHNSTON. What does price have to do with your job?

Dr. SAVITZ. Because the law also requires us to have the maximum practicable improvement in energy efficiency, and we have to also look at the economic impacts. There are various impacts the law requires us to look at—habitability, the economic impact, affordability.

Senator JOHNSTON. That is your statutory authority for the use of weighting factors?

Dr. SAVITZ. The law is really silent on whether you should have weighting factors or not, and as you recall the legislative history, it wasn't discussed at the time. There are certain references to the law such as that the law, one of the purposes is to provide for the development and implementation of performance standards for all new residential and commercial buildings designed to achieve maximum practicable improvement in energy efficiency and encourage the use of renewable resources, but it doesn't define what maximum practicable is.

Senator JOHNSTON. I think my own feeling is, and I am subject to being persuaded by other witnesses, but my own feeling is where the law is silent on weighting factors and where the weighting doesn't have anything to do with the energy, just has something to do with somebody's idea about it would be nice to save money for people, I don't think there ought to be a weighting factor.

I think people ought to be told that electricity is more expensive if it is in a particular area relative to gas or whatever, but I think you needlessly complicate this thing, and you put in a factor we are not dealing with.

We are dealing here with energy and not with dollars principally. With these uncertain price targets and changing supply problems I just think there is no need to do that.

Dr. SAVITZ. The law also requires us in section 310 to take into account economic cost and benefits, and that is where price can come in.

I will let Mr. Millhone also address the importance of the weighting factor.

Mr. MILLHONE. The problem in interpreting the legislation is that when it says energy efficiency, it doesn't define the energy it is referring to.

If you look at the energy that comes into a building, it is the end result of an energy process that starts in the ground someplace or in uranium someplace, and eventually becomes useful at the building site.

When you are talking about energy, are you only talking about that energy that comes across the building boundary, or are you talking about the energy that started out someplace that eventually had a useful purpose?

Senator JOHNSTON. I understand that argument. It is not that I think you are going about this in an illogical way. I just think from the standpoint of policy we would do better not to have the weighting factor because I think really we want, I believe we want to encourage the use of electricity because we know how to generate electricity. We have got an unlimited amount of nuclear energy, and a virtually unlimited amount of coal; 100,000 tons a year of capacity is idle; 20,000 idle coal miners, and we know how to generate that electricity, but we do know that with oil that it is not only finite, but Exxon tells us that we are going to go from domestic production of 10 million barrels a day to 8 million barrels a day by 1985. We know that is going down. We know gas is finite, although we hope we will find a little more of that.

I just don't know what we are achieving, however logical you are, by putting in this weighting factor, and it is a moving target, but I will listen to what anybody else has to say about the weighting factors today.

What authority do you feel that the Federal Government has to implement the BEPS standard without additional congressional action?

Dr. SAVITZ. Well, in order for the BEPS to be mandatory, Congress does have to take action. The law requires in section 305 after we promulgate the standards Congress then is to make a determination within 90 days about whether the sanction mentioned in the law should be in effect or not, so we can't promulgate them if Congress doesn't take any action concering the existing sanctions.

Also the act required that all buildings that use Federal funds—FHA, VA, any kind of direct Federal loan subsidies—must apply BEPS, must utilize BEPS after we promulgate them.

This will not require further congressional action. All Federal buildings by the original legislation must meet or exceed BEPS when we promulgate them.

Senator JOHNSTON. Frankly my reaction is that I would feel a lot better about using some of those sanctions first before we put the atom bomb of making these things absolutely mandatory because this is very experimental, very difficult, a very difficult job you have got, and I would just hate to come along without any test at all and say this whole thing is mandatory.

Dr. SAVITZ. When we promulgate a final standard next August we might ask Congress to consider waiting for the results of a testing program before deciding on the sanctions. That is an option that we are considering, and we hope the Congress will work with us at that time.

Senator JOHNSTON. What staffing and funding levels are necessary to put a workable final rule before the Congress?

Dr. SAVITZ. As I mentioned in testimony, we will be hiring up to 10 staff to do the final rule, and we will reassess at that point whether we need additional staff. Some preliminary estimates indicate we might need an additional 10 to 13 people, but the determination will be made after the 10.

Our current fiscal year 1981 budget has $7 million in it for the promulgation of the final rule.

Senator **JOHNSTON**. Is that enough?

Dr. **SAVITZ**. In doing an estimate of the work that has to be done——

Senator **JOHNSTON**. I am not inviting you to spend a lot more.

Dr. **SAVITZ**. We will spend it efficiently—that in reviewing what has to be done as a result of the public comments and as a result of the input we have gotten, we see that much work has to be done in the evaluation technique, in single-family and commercial buildings, and these alternative mechanisms so we might be able to well utilize an additional $6 million to do the various tasks in a complete way.

Senator **JOHNSTON**. Is legislation necessary to transfer the implementation responsibility from HUD to DOE?

Dr. **SAVITZ**. Yes, it is, and the administration has requested that. Right now the legislation has DOE promulgating the standard and HUD implementing it, and even though we have a memorandum of understanding so that we can all work together when it would come time to do the final promulgation and implementation of the standard, it is not a very good way, and we see more and more the two have to be tied together for implementation and promulgation, so legislation is needed, and the Senate Banking Committee has done that as part of their HUD authorizing legislation.

We would hope the full Senate will approve that and then the House will do similarly.

Senator **JOHNSTON**. Dr. Savitz, if you were to write a law in this whole area and you could just do it yourself without consulting anybody, what changes would you make?

Dr. **SAVITZ**. I think one of the things that—it is just off the top of my head. I haven't thought about it.

Senator **JOHNSTON**. The question was off the top of my head, too.

Dr. **SAVITZ**. The sanctions issue is one I would clearly look at. I think there are other sanction alternatives that we have thought about now that we didn't think about in 1975 and 1976.

Senator **JOHNSTON**. Which are?

Dr. **SAVITZ**. Instead of heavy financial sanctions, it could range from just not giving a building permit, the possibility of not having a utility hookup allowed, to letting the States decide what is most appropriate. Those are just three.

I think I would very definitely allow for a period of testing of the program to see how well it works and to provide funding to allow the testing.

Senator **JOHNSTON**. That is my feeling. There ought to be a time of testing of this thing. Frankly, my experience was with FHA and I think the FHA program standard works very well because they really protect buyers of FHA homes and set the standard really for all construction. Everybody knew what the FHA standard was. It was pretty simple. Just ordinary, old run-of-the-mill builders could figure out what the FHA standards were and comply with them, and there were inspectors there in place to enforce that.

Again I get back to the fact that I think these ought to be simple standards. Complicated things can't frequently be simplified too much, but I just think if we can get some understandable standards at least in this without these very complicated million Btu's per square foot on a sliding scale——

Dr. SAVITZ. But I think we need that in, too, for the people who want to be innovative; I would agree. I think another change would be to really insure that parallel paths are allowed, that a performance route is allowed or a more prescriptive route is allowed, that they would each have the same equivalent savings of energy, and the law allows us the flexibility to do the more prescriptive things, but we must promulgate performance standards.

Senator JOHNSTON. Let me ask you this. Is it possible to have standards beyond minimum standards so that where you might have let's say a C is the average, the minimum standard, but you have other grades like A, B, so if a person wanted to have a B house, he could tell his architect or tell his builder I want B standard and they would be one notch better?

Dr. SAVITZ. Well, the law says these are to be minimal and State and other people should meet or exceed these standards.

One of the ways you might be able to encourage people to do better than the minimum is by various incentives, or it also can help sell a house. Certainly utilities around the country already are having programs to encourage more efficient homes than meet minimum standards right now.

Pacific Gas & Electric Co. has such a program. The VA is discussing giving a more favorable rate to those homes that meet certain criteria, so I think there are mechanisms that can be explored that would encourage it.

In addition, I think people are starting to be aware of their fuel costs and are asking now builders what is the price of fuel that this house is going to consume, and so the cost is a marketing look builders could use. If their house is more efficient than the standard, you are going to use this much less energy, have a potential saving of this much on your fuel bill.

If we can get mortgage people, the financing industry to say that they will give a larger mortgage for homes that might meet your A or B, then percentagewise——

Senator JOHNSTON. Do you plan to have those A and B standards that are better?

Dr. SAVITZ. Right now we plan just to have a minimum standard.

Senator JOHNSTON. I guess that is a big enough job now.

Dr. SAVITZ. And we would encourage people to do things to exceed the standards and encourage the Federal Government itself to try to set the way, and FHA.

Senator JOHNSTON. Let me ask you this, Dr. Savitz. I am a builder and I finally figure out what all this means and I finally figure out how much gas—I am going to put gas in the house and how much gas I can use, and then what do I do from there on out? I just build my house and hope it works out?

Dr. SAVITZ. You design your house. The law requires only compliance equal to or less than the design energy budget.

Senator JOHNSTON. Requires what?

Dr. SAVITZ. Only requires the house be designed to meet the design energy budget.

Senator JOHNSTON. How do you figure out that design?

Dr. SAVITZ. We have some alternatives as to how you can meet that design which are more the cookbook approach, but you can also run a calculation that you would find out how many Btu's you would be using for heating, how many Btu's for cooling, how many for water heating.

Senator JOHNSTON. What I am getting at is that you follow the cookbook and the plan and therefore you know it will work, or you just wait until the house is built and you put the electric meter and the gas meter in?

Dr. SAVITZ. You follow the cookbook and hope that it is built according to the cookbook so when they say they are going to put R-30 in the roof, R-30 is put in the roof, and you operate it according to certain conditions. You have your temperatures set at certain degrees.

Senator JOHNSTON. Pass or fail is based on what?

Dr. SAVITZ. On the design, that is, before you start to build you show the building inspector a plan that has been certified that it meets BEPS, let's say a precertified plan or a precertified minimum property standard, and that is all you have to do. You have met BEPS.

Now what you would hope is that you as the homeowner would get the home that is energy efficient according to that plan. One of the implementation proposals is that the State might want to inspect at one time during the construction to see that the building is being constructed according to the plan energy-wise.

Senator JOHNSTON. I think you answered my question. The point is it doesn't matter whether it actually works. It matters whether you follow the plan? I don't mean to say it doesn't matter, but it is irrelevant for the purpose of whether you pass or fail?

Dr. SAVITZ. That's right. If the plan passes, it does. We have had experience like with the GSA building that was designed to an energy budget of 55,000 Btu's per square foot per year, and the first year it did not operate according to that design. It was over 70,000. The owners, the operator and manager of that building have worked with the system and have gotten it down very close to the design, so it would have passed originally, but then you still need to do some work.

Senator JOHNSTON. Is there any warranty expressed or implied to the buyer, to the home owner?

Dr. SAVITZ. No. There currently is no warranty to that. The liability question has been an issue that has been raised at our hearings by many architects and engineers and builders as to what will be the liability.

The liability will be the same as it is now for health and safety and other requirements.

Senator JOHNSTON. There are a variety of results on the liability question State to State. I think you need to get a policy on that.

Mr. KESSLER. Dr. Savitz noted we have gotten a tremendous amount of inquiry about the liability issue. We have begun to look at it very carefully and that is one area which we would like to explore in depth with a view toward the proposal coming out in February.

I just want to very briefly comment that there are many, many issues, but two things that one would want to keep separate is there is one liability that might attach a person designing the building, another liability that might attach the person who reviews the plans and makes sure that they meet the performance level or the prescriptive equivalence. Those two are very separate roles.

Basically to the first person designing the building there is nothing in the statute right now. Something could be created. I am not for a moment suggesting or recommending that. Something could be created. By and large today that is a function of the contractual relationship between the parties, one way or another.

Also you, of course, get the builder involved in the process, but it depends what the people who are designing, and the people who are building have promised to do. It then becomes also a question what is required on the implementation side. For instance, if on the implementation side there is a requirement through State law that the plans are certified and that the builder then agrees and makes a representation that he agrees to build in accordance with those plans, obviously if the consumer or user ultimately finds that that has not been the case, there is possibility of legal action for damages and a variety of other things.

The real question now comes I think, and the thing that concerns people most is not that. That is pretty clearly understood in terms of existing law today. It begins to attach with this performance thing, it is an awfully new thing—are you really going to require that the building actually perform that way.

Senator JOHNSTON. I think you need to decide that now. With FHA you have an FHA warranty. I forget what they provide, but it seems to me they warrant everything for 1 year, whatever the FHA warranty is. There is an FHA warranty that is very specific.

Now you couldn't foreclose States from requiring more than that, but I think we ought to think through what result we want to achieve on warranty. Maybe you want to phase that in, maybe not have a warranty attached initially during the trial period but require it later on when the standards are better understood.

Senator Ford, this is Dr. Savitz. Do you have any questions for her?

Senator FORD. Not at the moment; I am just trying to protect the back door.

Senator JOHNSTON. Thank you very much, Dr. Savitz, for your testimony. Yours is a very challenging and very difficult job here, and we want to be helpful to you, and to the extent you need any further legislation to make this work, we will be glad to try to get it for you.

Dr. SAVITZ. We thank you, and I thank your staff for their support.

Senator JOHNSTON. Thank you. Next we have a panel with Dr. Arthur Rosenfeld and Dr. Mark Levine from the Lawrence Berkeley Laboratory.

They developed the energy budget approach and the computer program that produces the BEP's numbers.

Dr. Rosenfeld, if you will please proceed.

STATEMENT OF DR. ARTHUR H. ROSENFELD, PROGRAM LEADER, ENERGY EFFICIENT BUILDINGS RESEARCH LAWRENCE BERKELEY LABORATORY, BERKELEY, CALIF.

Dr. **Rosenfeld**. Good morning. I will try to tell you in a couple of words how I fit into this debate on building performance standards, and then I will actually try to modify my testimony a little bit to take on particularly some of the questions that you just asked of Dr. Savitz. Since we have had some experience in California now since 1977 with all these issues, and obviously these questions have come up, you might be interested in knowing what we thought about them.

I blundered into the energy efficient buildings business in 1975 I guess because I was a physics professor sort of minding my own business except that the State decided that it wanted to promulgate residential and commercial building standards, and in fact put out some set of standards which I read and found a sentence which said that windows in houses should be limited to 15 percent of the floor area, and they never mentioned the word north, south, east, or west.

Apparently the know-how in the State of California at the time didn't realize that the Sun is shining on the south side of houses, not on the north side, and I decided to try to convince the State that it should exempt south- facing glass, and it turned out it needed a computer program to do that, so I wrote the program and that ended up being the program used for the State residential standards, and so somehow or other I feel I have been through this once.

Since then, my group at Lawrence Berkeley Laboratory undertook the program DOE-2 which has become the analogous tool for the Federal standards, and Mark Levine on my left is the man who has run that program now for the last year or so to come up with the details.

OK. In running through my testimony I first give one unfair and heart-rending example simply pointing out that there are buildings going up all over the United States today with no insulation whatsoever. It may have been acceptable when they built your house, but it is still going on, and the only point I want to make is I don't want to see us delay too long in getting standards perfect before we mandate them because every year we do that, my guess is that 20 percent of the houses will go up without a shred of insulation and you are going to lose a thousand gallons of oil when they could be getting along with 300, and let's not quibble until Rome is perfected before we get something done.

I guess I would like to point out that is pretty much what has gone on in California, that we put the standard into place fairly promptly.

Senator **Johnston**. When?

Dr. **Rosenfeld**. They came in force in 1977. In fact, they are not enforced at all. The builder takes his plans to the code official. He looks at them. They are the same plans he has seen day after day after day. They are in fact cookbook recipes. He stamps them and that's it. There is probably some cheating. There are some pictures floating around California now of someone who sold their home where some idiot put the solar collectors on the north side of the roof because he doesn't know what he is doing, so I am not going to claim perfection and yet somehow or other the State has survived and I think we have saved a lot of energy.

OK. The next point I would like to take up is the question of the cookbook. I am completely happy and charmed by Dr. Savitz's statement that is what DOE is going to do, but certainly that is what has to be done. Let me point out in fact that that is an idea which has been around for sometime, that is, when the American Society of Heating and Refrigeration and Air-Conditioning Engineers promulgated its first standard which was the voluntary standard in 1975, they devoted nine chapters to saying what should be done on a component base way of bookkeeping, said you have got to have R-38 in the ceiling in certain climates, but they put in chapter 10 in which they said now let's consider tradeoffs. They will be based on keeping the energy budget constant, and if you want to put less or let's say if you want to put bigger windows somewhere because you like the view, then you can make up for that by putting more insulation in the attic or what have you, and that is used some of the time.

Nevertheless, certainly the California experience is that in designing, in getting plan checks for residences nobody but nobody uses the computer, and only in large buildings are computers used, and then I think they will be used anyway because it pays to optimize the complicated heating and ventilation system, so the computer is absolutely necessary to do the economic analysis in the first place and to decide that above a certain altitude in the mountains it pays to go to double glazing. Once that calculation has been done, once it is up to the State to publish the cookbooks and say this is what you shall do in such and such weather, and these are the tradeoffs which you can abide by under those conditions, that is by and large what will be enforced.

Now I guess as I proceed through my testimony I will make just a couple of remarks about the status of standards in the world which is becoming aware of rising energy prices, and that is called section 2, and then I will get on to the things that we have decided about weighting factors in California.

I did first want to say that I believe that standards have done a great thing for this country, and particularly sitting in a room during the Senate where you people considered the automobile standard a few years ago, I think in retrospect those have been a very wise thing, and I hope that we will look back on the building standards in a few years and be equally pleased with them. I'm sure we will.

Specifically with the case of automobile standards I thought it was fun to ask the following question—the 1985 car as you gentlemen mandated is going to be more expensive than the 1975 car was by something like $1,000 in today's dollars.

Now some of that, of course, is extras, but some of it is really because it is made out of lighter, stronger materials and it has six gears instead of four, but that saves gasoline and $1,000 more of car saves something like 300 gallons worth of gas in a year. If you take some reasonable value like 10 percent real interest rate, you can get a yearly cost for the better car in dollars and gasoline savings and divide one by the other, and the 1985 car is going to be saving us gasoline at the cost of 50 cents a gallon.

Now in 1985 we sure as hell are not going to buy gasoline at 50 cents a gallon, so it was a very wise thing to look ahead, and I think you deserve lots of applause, and I think we ought to keep up the same sort of good work and momentum on building standards because they have even larger opportunities.

Now following that line for just a minute more, we have passed appliance standards in California, and since 1977 just the refrigerator standard alone seems to have permitted the deferring of the construction of one powerplant worth $1.3 billion, and if we go for long-range appliance standards we will probably be able to defer construction of another powerplant, and the cost of conserved power on refrigerators is 70 cents a watt and $2 a watt is the cost of a new powerplant, so that would be a marvelous deal.

Senator **Johnston**. Is that being enforced?

Dr. **Rosenfeld**. Yes. The building standards are terrible to enforce, but appliance standards are easy. Nobody sells refrigerators in California unless they comply with the standard.

Senator **Johnston**. They are that much more efficient? The standards are that workable?

Dr. **Rosenfeld**. Yes. That has worked like a charm. The building standards are essentially unenforced.

Senator **Johnston**. Why are they essentially unenforced?

Dr. **Rosenfeld**. Just the State doesn't have its act together, and there is a shortage of officials who care.

Senator **Johnston**. They are not inherently unenforceable?

Dr. **Rosenfeld**. No. Everybody gets his code check, but if you look at some obviously nonconforming houses, the code official checked those because he is understaffed and nobody gave him an assistant. It is not malicious. It is just the usual lack of funding. Maybe you could blame it on proposition 13.

Now let's take up the California view of what you call the weighting factors. I want to make two remarks about those if I may. I think in some sense the words "weighting factor" is slightly unfortunate because it suggests there is one elementary factor which is correct and then somehow or other is being weighted, and I don't see it that way.

That is, let me consider a house. At the end of the year, there will be two different meters. The gas meter for a typical California house is 600 therms, which is 60 million Btu. The electric meter will read 6,000 kilowatt hours, and they are different, so you have got to add them somehow. The question is how.

Now in some completely rational world I think you would add a million in effect, and let's talk about that because you said to Dr. Savitz that there is no shortage of electricity, for example. I guess I would say if there is no shortage of electricity, how come it is so expensive we can't afford it?

Senator **Johnston**. I will give you the answer to that, too.

Dr. **Rosenfeld**. Let me make my little impassioned sentence.

Senator **Ford**. Dig your own hole, Professor.

Dr. **Rosenfeld**. There really is a limited amount of energy in the world. The total world supply of oil is only equivalent to 1 day's sunlight. The only problem is the sunlight is very diffused and to get that sunlight and cover the world with solar collectors would be too expensive.

There is an infinite amount of coal, but you have got to mine it, and an infinite amount of deuterium for fusion, but you have got to figure out how to make it work, and those things are all expensive so in the long run we are not shy on energy. We are shy on cheap energy, and therefore in some sense if we want a life with the best amenities we can, it is a question of what we are willing to pay for it, not the energy.

In a completely rational world I guess you would say if you have got a gas meter and an electric meter and we want to design a house, Mr. Architect, so that the residents get the amenities they need for the least price because that is what counts—the trouble with that is that the prices vary all the time and so it is difficult, and I am not selling that there should be a price budget, energy budget, so the compromise is all right. Let's pick an energy budget, but I think the energy budget should reflect price and if we are going to run out of oil, the market will take care of that. The price of oil will go up.

If we run out of electricity because it is dirty, the market will take care of that. The market has taken care of it very well. The price of coal has doubled in the last few years because we now know we have to put abatement machinery on them and the price of electricity went up. Those things are reflected in the market, and we ought to be aware of the market. It is really too big to ignore.

Senator **JOHNSTON**. Yes, but the market really doesn't work all that well. We have had regulation of oil, will have until September 1981. You have got the regulation of natural gas and will have up to 1985 or beyond, and I just think price is not an accurate enough guide here.

I think a million Btu's is much better. You say a million Btu's is not substantially the whole question.

Dr. **ROSENFELD**. Now having made that point that price isn't the only thing, the fact remains the meter reads a certain amount of kilowatt hours, and you have got to multiply by something to make it equivalent to million Btu's.

Now if you grew up thinking that electricity was created by magic from the socket, you would take the point of view you should take the kilowatt hours and multiply by 3,415, which is the number of Btu's in a delivered kilowatt hour, but I assert that is just the school you went to.

If you grew up going to the school of resources, you would multiply by 11,500 and surely there is no law which says 3,415 is in some sense more holy than 11,500 which happens to be the resource energy back at the powerplant.

I would then say since it is hard to tell which is right, probably we should go in the direction in which one is closer to money, and in that sense there is no doubt that the resource electricity weighted at 11,500 is a lot closer to being comparably priced for heating than 3,415.

Now people will have to decide, but I do want to make the point that the problem is arbitrary and there is nothing holy about electricity as a resource. I am inclined to think the other is better.

OK. One small consideration that came into California with respect to making electricity too cheap was the following—if you don't have some constraint on electricity, you find that the power company itself is under constraints to build a lot more peaking plants, for example.

Senator **Johnston**. That is my problem. We are trying to talk about building performance and insulation. It should not be the goal of people who design these standards to figure out how many powerplants powerplant people ought to build or whether they ought to be run on nuclear or coal or gas. I mean your job is to figure out what makes a building energy efficient and not how many peaking plants they build.

We will decide that up here. We are working on that right now. The oil backout bill, the Fuel Use Act—it shouldn't be decided by people who are designing energy performance standards for homes.

Dr. **Rosenfeld**. Fine, but when you pick the weighting factors, you are deciding how many plants are going to be built and how much I am going to have to pay for electricity as a consumer.

Senator **Johnston**. You are not supposed to be deciding that, in my view. We are supposed to be deciding that. You are supposed to figure out how to make a building energy efficient, and you shouldn't give them a premium because they use one kind of fuel as opposed to another. A window that has got two panes is more energy efficient in a gas-cooled house as well as in an electrically cooled house or heated house.

Dr. **Levine**. Senator Johnston, I will be on later, but I would like to just make a comment on that.

I agree with you. I think the purpose of the building energy performance standards is to cause energy efficient houses to be built. In the process, however, of developing the standards, one has to ask the question what is the impact of different types of standards, different levels of standards, different types of weighting factors on things that are important, and that means the impact on energy use in a house, the impact to the consumer and how much it costs him, the impact on electric utilities, so that I think that though you are absolutely right that the intent of BEPS is not to do these various other things, it would be inappropriate not to consider the effect of BEPS on these other factors that are very important, and I think that is what Art is referring to when he talks about the number of deferred powerplants that have to be built. That would be an impact of BEPS.

Senator **Johnston**. As I say, I don't think the designers of BEPS in DOE should look at that at all, not at all. I think you should come up with standards for home insulation and let those issues be decided in other places, in the State PUC's, in the Congress, and in FERC and other areas. That should not be the concern of insulation people.

For one thing, they can change fuels. You can have an oil-heated house that changes over to gas later on. That is not the principal reason. The principal reason is that we ought to be comparing always apples to apples, energy insulation to energy insulation and not what the effect is it is going to have on nuclear powerplants.

I suspect that in California you would weight that very heavily against nuclear because nuclear is not popular. In other areas of the country you get a bonus because you put in coal. We shouldn't be doing that. We ought to be insulating homes.

Dr. **Rosenfeld**. OK. I will get off of that. I have three transparencies I want to show you to put that in context.

Senator **Domenici**. How do you take into account the weighting factor for electricity, since the cost varies greatly from one part of the United States to another?

Dr. **Rosenfeld**. I believe if you put the weighting factors for electricity in, you should certainly have them down to the State level and maybe even to a single utility level.

I am the first to say that if there is a surplus of electricity, and it is cheap, then you ought to use it all up, and therefore you would have a low weight for electricity in certain utility districts, so I believe in weighting factors, and I believe that they should be down to the individual utility district and they should not be the business of the Federal Government.

Senator **Domenici**. In many cities there are electric wires whose energy comes from coal. In the street you have the natural gas line. One house went all electric when it was being promoted and another one went all gas when we were promoting it.

In the future, are we going to say that if you build this house with this kind of energy, you get a different weighting factor in your insulation standards than the next door neighbor who has got a different standard?

Dr. **Rosenfeld**. The main problem is the following. Consider a house which is being designed for a life cycle minimum in a State or in a typical situation where the cheapest heating fuel is oil and gas, where the cheapest cooling fuel for your air-conditioner is electricity.

Now we want to design the cheapest house, life cycle minimum house. There is no way we can get around the problem of how you compare the electric energy for the cooling with the gas or fuel for the heating. We have to weight them somehow because the house uses both, and the only point I am addressing is when you do that, if you are trying to consider the best deal, and you are trying to get the cheapest, most amenities for the least bucks, you are going to weight the electricity according to the weighting factors for high price, and you can do anything else you want, but anything else destroys it.

Senator **Johnston**. Do you understand this issue, Peter? They have got to make a choice and whatever choice they make it seems to make somebody happy and somebody sad.

I am not trying to make anybody happy or sad. I am saying you ought to look at delivered space heat in millions of Btu's at a home. Now maybe that would make the gas people unhappy because some of the gas heat goes up the stack, it is not the delivered space heat.

Dr. **Rosenfeld**. If it were just heating it would be easy, but there is heating and cooling and cooling is electric and heating is gas and you have got to face that issue. You have got to weight them, add them, optimizing the design of the house.

Senator **Johnston**. All right. With respect to heating then, it ought to be on millions of Btu's.

Dr. **Rosenfeld**. Heating is no problem. The cheapest way to heat is gas—done. Now let's consider the real problem. It is heating plus electricity.

Senator **Johnston**. Tell me about the air-conditioning.

Dr. **Rosenfeld**. Air-conditioners use electricity, and you have got a bill from the electric company and a bill from the gas company, and you just add them in dollars, but the standard didn't want to do that because dollars keep escalating and we can't keep track of them, and so the recommendation was to go to an energy budget, but you have got to add electricity, convert electricity to Btu's before you go and add it to the gas bill.

Now you have got to decide is electricity 3,412 Btu's per kilowatt hour or is it 11,500 because that is what they burn back at the powerplant, or should you weight it by price? If you do that, it turns out to be the same as 11,500 anyway, and all we are saying is give the consumer a break and take that into consideration when you make your weighting factor.

Dr. **Levine**. I am going to talk about weighting factors when I come on, and I am going to maintain that they are not nearly as important and they don't deserve nearly the amount of time that we have spent on them.

Dr. **Rosenfeld**. I think that is true.

Senator **Johnston**. Let's do move along. We have got some other witnesses and we are falling behind time. Let's move.

Senator **Domenici**. Were you speaking of the weighted factor or this whole process?

Dr. **Levine**. I won't take Art's time right now, but I will get to it soon. I am talking about just the weighting factor.

Senator **Domenici**. I am talking about the whole process. We start off with the minimum standard we want to set because we have been terribly wasteful. We are getting down to a prescription per home. We are never going to get that done. It is not going to be delayed 1 year, but 10. This is a minimal standard proposition for the Nation.

As I understand it, it seems to me we want to punch a computer in and have an energy doctor prescribe, for each region of the country, a prescription for the contractor to build a home. To me the whole thing is so complicated that it will fall of its own weight.

Senator **Johnston**. Let's move on if we may because this is our second witness and we are not a third way through.

Dr. **Rosenfeld**. I will try to talk loud and go fast. I made a plot here which is to try to show you where BEPS compares to what is going on today, and compared to what could happen to try to give you the idea that it is pretty easy to conform to BEPS, and this is the scale on which the weather gets colder as you go from here to here.[1]

[Showing Vu Graph.]

This point is Houston, Tex. This point is Chicago. This is Minneapolis, and the fuel use per 1,000 square feet of house is like that, and the crummy cardboard houses we have today use a lot of energy and go way up there and run off scale before you get to Minneapolis at 1,100 therms per house.

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[1] This slide is reproduced on p. 51.

As prices have gone up, the building industry has reacted very well and the big heavy line here is what the National Association of Home Builders says is going up in the United States today. Each dot is from a survey of theirs in 1975. Each dot is an actual city they surveyed, and the black line is my attempt to make a smooth curve to that.

Now what about BEPS? The proposed BEPS for 1980 is fairly conservative. It was assumed that there will be no new fangled ideas, no passive solar, concentrating windows toward the south, no tight houses with heat exchangers—just essentially insulation and double or triple glazing, and that gives you this line here which as you see is about 30 percent better than current practice.

Current practice is getting better all the time. If we were willing to build tight houses and put heat exchangers in, which is the more lucrative way to go, we would come down to the second line here which you see is about twice as much in advancement. If we are willing to concentrate the windows toward the south, put on insulating shades at night, we can get away down to here.

This line is interesting because the amount of energy which the average American uses for heating hot water now is that green line which is nearly independent of the weather, and you see that it is in fact easy today to get down to less energy for space heating than we now use for showers.

Senator JOHNSTON. What are insulating shades?

Dr. ROSENFELD. Insulating shades means you have pull-down shades at night or closing shades. Instead of being something flimsy I see through, they look a little bit more like a parka or like styrofoam with something pretty on the inside, and you can keep an awful lot of heat from going out of your house at night, and that is a standard procedure in energy efficient homes.

Senator JOHNSTON. Do they also work for air-conditioning?

Dr. ROSENFELD. Sure, but of course at night—they keep the summer sun from beating into your house.

Senator JOHNSTON. I see. That's what I say. They don't work at night.

Dr. ROSENFELD. At night usually it is cool. You may even want fresh air coming in at night in some parts of the country, so OK, so the idea I want to give here is not of—the builder who wants to build a house house as you called it will stick to this line and he can get there for something like $1,000.

The innovative builder will soon learn it is a lot cheaper to aim for this line and have very little trouble conforming with BEPS, but he has to learn a few new tricks and probably that is one of the important things in BEPS.

The next thing I would like to flash before your eyes is we don't have a big collection, but this is the same slide with a bunch of new buildings on it. I won't run through them, but they are all successful buildings that cost less than $1,000 or $2,000 more than current practice, and they are all way the heck down here which seems to prove that we can do it and we probably made a terrible mistake by not having a few thousand of these buildings around the country for people to check the tires.

Senator JOHNSTON. May I ask you to sum up very quickly? We have got another six witnesses for this morning.

Dr. ROSENFELD. The last one I will show you then is a little bit of an idea of what current practice is up to today where BEPS is. This is the same sort of plot except this time it is the time that is going along and the gas consumption has been divided by the temperature, so that Washington and Denver should lie on top of one another.

We tried to correct for the weather, and the answer is you can't. What you see is that in some parts of the country as the price of energy goes up, the houses get better and better, and in fact then Denver looks like it will overtake the proposed BEPS about 1992 with or without BEPS.

Of course, if we had BEPS we will pull it down by then. On the other hand, there are places where we really are lagging. Why Washington, D.C., is 60 percent worse than Colorado I have no idea, but it sure looks like it is indeed shameful and we ought to put some pressure on some parts of the country to get their act together.

That is my simple conclusion. Thank you.

[The prepared statement of Dr. Rosenfeld follows:]

Testimony on B.E.P.S.
(Building Energy Performance Standards)
Before the Subcommittee on Energy Regulation,
Senate Committee on Energy and Natural Resources

June 5, 1980

by

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June 4, 1980

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June 4, 1980

I. INTRODUCTION

I want to talk to you about the usefulness of B.E.P.S. (Building Energy Performance Standards) as a way to speed the response of the buildings industry to rising energy prices.

Building practice has improved dramatically since 1973, but one can still not buy many homes or buildings designed to minimize the owner's life-cycle cost. And there are still flagrant examples of construction of uninsulated homes and ignorantly designed buildings.

A. A Colorado Example of the Need for Insulation

In part III of my testimony, I will discuss uninsulated homes which are still being built today, but I would like to make the point right now about how the absence of effective energy studies in many parts of the country affects real people-- and especially low-income people. My friends at the Solar Energy Research Institute near Denver tell me that right near SERI some (uninsulated) low-cost homes are being built today. If there were building standards, the builder would be required to install about $1000 of insulation, but would slash heating costs by 60%. Specifically, his cost for conserving gas would then be about $0.04 per therm of gas conserved. With standards absent, the builder is selling uninsulated houses to low-income people who will have to pay today $0.40 per therm (10 times more), and soon $0.60 per therm, for gas to heat their new "gas guzzling" homes, thus depleting America's supplies and adding to international tensions over energy. That's inexcusable!

Having stated my advocacy for Building Standards, let me explain who I am, and a bit about how I have arrived at my point of view.

I am a Professor of Physics at the University of California, Berkeley. Until 1973, I spent most of my professional career studying particle physics working with Fermi at Chicago, and later with Alvarez at Berkeley. I served as Chairman of Alvarez' Nobel Prize winning group after Alvarez switched his interest to astrophysics. But in 1973, I became interested in why the United States uses about twice as much energy as Western Europe, for a standard of living which is certainly not twice as high. I soon became convinced that long-range standards and other measures to improve the efficiency of "gas-guzzling" automobiles, airplanes, appliances, and buildings can produce conserved energy two to ten times more cheaply than one could produce new fuel supplies and new power plants.

B. DOE-2 -- A Public-Domain Computer Program

In 1975, I wrote a computer program (TWOZONE), which convinced the California Energy Commission to give credit for passive solar features in its proposed energy standard for new homes and buildings. In 1976, I convinced California and ERDA (The U.S. DOE's predecessor), to co-sponsor a public domain computer program for building energy analysis called Cal-ERDA.

Cal-ERDA was used to calculate the 1977 California Building Energy Performance Standards for commercial buildings. Separately, ERDA grew into DOE, which provided continuing support to extend the Cal-ERDA program into DOE-1, which could still handle only commercial buildings, and now into DOE-2, which can also be used as a tool for the design of residences and innovative buildings.

C. Design of Most Homes and Buildings Needs No Computer

During all of this time, I have argued that computer programs are useful for calculating building energy budgets, and for the design of multi-million dollar buildings, or housing developments, but are not needed for the design of homes and small buildings.

A computer program should of course be used to publish sample conforming designs, complete with tables of trade-offs. But I maintain that it is far more effective for such routine calculations to be performed wholesale at the state level under the supervision of experienced architects and engineers, than to leave them entirely to the builder, who is inexperienced at calculations. The beauty of performance based standards is that the innovative architect or engineer can run a computer program, and have all the flexibility that he desires, while the conventional builder can confidently consult his manual of recommended practice and trade-offs.

II. RECENT EXPERIENCE WITH ENERGY PERFORMANCE STANDARDS

I just mentioned in the introduction that energy performance standards are of important consumer and national benefit in speeding the response of the marketplace to rising energy costs. Let me give some recent examples:

A. Auto Fuel Economy Standards

I first want to point out that the fuel-efficient 1985 automobile compared with the average 1975 guzzler, will save gasoline for its owner at a cost of conserved gasoline of about $0.50 per gallon (in 1980 dollars), compared with the retail price for 1985 gasoline of at least $1.50 per gallon (again in 1980 dollars).

I submit that this improvement has turned out to be a benefit to the consumer, and to the nation. I don't know or care what fraction of the improvement would have taken place without federal standards, just because of the invisible hand of the marketplace and of foreign competition. But my impression is that the standards have indeed been helpful in protecting the least wise and least innovative automobile companies ~~for~~ from themselves, and in providing a better consumer product.

(Let me spend a paragraph showing how I calculate the cost of gasoline as conserved by the 1985 standards is $0.50 per gallon.

(As everybody knows, in 1975 the U.S. auto fleet, designed to burn cheap gasoline, averaged 14 miles per gallon, as compared with about 20 mpg for imported cars. The U.S. Congress decided wisely that by 1985, fleet fuel economy should reach 27.5 mpg with decreased emissions in addition. These two improvements [fuel economy and emissions] will raise the cost of a 1985 car by about $1000 [in 1980 dollars], and hence will raise the annual cost of car ownership by about $180 dollars, but the improved car will use about 360 gallons less gasoline every year, so the consumer's cost of conserved gasoline* is:

$$\frac{\$180\text{/year for the better car}}{\$360\text{ gal/year saved gasoline}} = \frac{\$0.50}{\text{gal saved}}$$

Thus, as I asserted, the cost of conserved gasoline is about $0.50/gallon.

I conclude from the arithentic above, that long-range performance standards are a success, and I praise your committee for beginning to consider the 1995 car which I think should achieve another two-fold improvement over the 1985 standards.

B. Appliance Standards

Before I turn to building standards, let me mention California Appliance Standards, which have been in effect since 1977, and are upgraded as energy prices rise.

In particular, let's discuss the success of refrigerator standards. I submit two facts:

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* Assuming that we generously give the emissions clean-up a "free ride" in terms of automobile cost increases!

(1) short range refrigerator standards are saving electric power at pennies per watt, rather than the $2.00 per delivered watt of installing new generating capacity.

In 1976, California refrigerator standards were passed. The average new refrigerator* used 150 kWh per month (200 watts base load), although the best three refrigerators on the market in the same class used only 100 kWh per month (70 watts less) and had a first cost of no more than the average (and, due to the energy savings, a life-cycle cost of $500 less than average).

The 1977 and 1979 short-range California refrigerator standards have pushed purchases in the direction of the most efficient models, and stimulated the appearance of even more efficient ones. As the present model of refrigerators and freezers (which last about 20 years) are replaced by 1997 we should have in place 15 million units as good as the best now on the market. As a result,we shall save 1000 megawatts of base load power, just in California. As a rule of thumb, this would translate into the power output of about 1.5 baseload power plants,** costing in today's dollars perhaps $1.5 billion each. (Reference 1).

(2) Long-range standards could save even more power at $0.70/watt.

The existing short-range standards seem to have been very good for the California consumer; even better would be to pass long-range standards which stimulate and advance the appearance of even better refrigerators, using as little as 50 kWh/month for the same size and defrost class. A second generation of these appliances would save a second 1000 megawatts. An Arthur D. Little report (Reference 2) calculates that the life-cycle-cheapest refrigerator (50 kWh/month) will cost more than today's electricity guzzler but only by about $0.70/watt saved vs. about $2/watt of new base load power (again allowing for transmission, distribution, and system reliability).

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* 15 cubic feet; semi-automatic defrost; top freezer.

** Operating at 70% capacity factor, with about 10% losses during power transmission and distribution.

So, I repeat: from our experience with automobiles and appliances, energy performance standards, particularly long-range standards, can be a boon to the consumer, and should be widely inplemented.

C. California Building Energy Performance Standards

The overall experience with energy-efficient building standards in California is an extremely instructive one for BEPS — but it is also mixed. In general, it appears that the standards are being accepted and implemented, but not as quickly, easily, cheaply, or uniformly as was originally expected. Even today, one can find new buildings in California that in no way conform to the design and construction practices required by the Title 24 standards. (There are painful examples of "solar homes" with collectors on the north-facing slope of the roof!) At the same time, the stock of new buildings, on the whole, appears to be performing significantly better than the minimum levels required under Title 24 -- partly because of compliance by many of the designers or builders, and partly because a significant share of these new buildings are designed and built to exceed the standards -- either in response to market pressures for more energy-efficient buildings, or in response to specific (utility-sponsored) incentive programs. The next several sections will explore these diverse trends in a little more detail.

(1) Title 24 Residential Energy Standards.

In 1973, the average uninsulated Northern California house used 1000 therms annually for space heat. Residential building standards were introduced in 1975 and by 1977, construction practice in new homes was probably already down to 300-600 therms (plus about 250 therms for hot water), Title 24 of the California Administrative Code was amended in 1977 to require essentially the best of then current practice, (300-400 therms), and has since been upgraded to require double-glazing in some parts of the state which reduces annual gas use to about 250 therms.

Despite some initial objections to the California building standards and law suits by home builders and their lobbying arm, Building Code Action, a steadily growing share of the new homes in California are being built to meet or exceed the standards. Increasingly, they are being perceived by builders and buyers as more efficient, comfortable, and desirable. The home builders have dropped their legal challenge of the standards. In fact the Energy Commission is now developing revised standards and the California Building Industries Association and other industry groups are participating in formulating long-range standards which should be as good as or better than BEPS. Such revised standards, for homes in Northern California, would reduce space heat needs to about 150 therms, or two-thirds of the gas used for domestic water heating.

To understand California's spontaneous move to "better-than-BEPS" standards you first have to understand California's wise and pioneering policy for progressive pricing of natural gas and electricity. Declining utility rate structures are being completely dropped in favor of very cheap residential "lifeline" rates for the first small block of gas and electricity, followed by an intermediate block at about "average-cost" prices, and then by a "tail block" set equal to the "marginal" replacement cost of natural gas ($0.70/therm) or electricity ($0.09/kWh). These new price schedules are of course a strong signal to the California builder and to the home buyer to move in the direction of improved energy efficiency. The California building standards help drive home that same message.

(2) The average new Northern California home is better than required by California standards. It uses about 225 therms less resource energy.

The combined effect of the California Building standards (which have helped create a basic awareness of energy-efficient design), and the economics of the marketplace, work so well that 2/3 of the homes built this year in Northern California service territory of Pacific Gas and Electric Co. (PG&E) currently qualify for the PG&E "Energy Efficient Homes" program, which provides builders with cash incentives based on a point system for homes which are more efficient than required by Title 24.

(More details on PG&E's "points for energy efficient homes" are as follows:

PG&E awards points for all energy conserving features beyond those required by California building standards (Title 24), or appliance efficiency standards (Title 20). Each point is equivalent to 3 therms of gas or 30 kWh (which is 3.5 therms of resource energy). For each point above 50, the minimum level to qualify, PG&E offers a $2.00/point cash incentive to the builder. For the first 50 points there is no such cash payment, but of course the builder can advertise that his "50-point home" will use 150 therms less than Title 24 each year, thus reducing the annual gas bill by about $100. PG&E also provides further advertising support to builders qualifying for their programs.

Out of the first 16,000 new homes connected in January and February 1980, 10,000 qualified for the 50 point threshhold, and the average qualifying house probably went 25 points beyond threshhold for a total calculated savings of 75 points, or 225-250 therms of resource energy. These savings apply to electricity and gas usage for heating, cooling, and hot water, as with BEPS, but also to energy used by other appliances. Nevertheless it is interesting to compare the PG&E program's over California standards with the savings of the proposed BEPS over current practice, as shown in Table I .

Table I: Fresno resource energy use per 1000 sq. ft. of home. Source: BEPS Technical Support Document No 3: "Energy Budget Level Selection." One million Btu is abbreviated 1 MBtu. 1 MBtu = 10 therms of gas.

	1975/76 Building Practice	Proposed BEPS	Difference (= savings)
Gas Heat (MBtu)	22	10	12
Cooling (Site MBtu)	(7)	(6)	(1)
(kWh)	(2000)	(1800)	(200)
(resource MBtu)	24	20	4
Total Heating and Cooling (Resource MBtu)	46	30	16
Savings (Equivalent Therms)	460	300	160

Table I shows that a small BEPS house in Fresno (Northern California Central Valley) should use about 160 therms (16 MBtu) less resource energy than 1975/76 building practice, which conforms roughly to Title 24. Accordingly larger, more typical BEPS home of 1500 ft^2 should save about 240 therms which is just about the same as the average calculated savings of a house qualifying under the PG&E Energy Conservation Home Plan. My friends at PG&E (John Hailey, Betsy Freig, and Brian Richardson) estimate that the improved 75 point home costs the builders about $1000 more than a Title 24 home. Hailey, et al. also tell me that recent polls show that many of California's home buyers are willing to pay $800-1000 extra for such energy conserving features!

In all fairness, several of the other utilities in California have either established program's similar to PG&E's, or are in the process of doing so. Moreover, the California Public Utility Commission has recently announced an important change in the rates for paying for new gas and electric service connections. Historically, such "service extension" costs have been heavily subsidized by existing customers with builders receiving a substantial "free-footage allowance" based on the amount of load they added to the system! The PUC's proposed ruling would reverse this pattern, providing subsidies to connect new buildings only to the extent that they perform better in conserving energy (and using solar and other renewable resources) than required by prevailing standards. These new "line extension" rules will undoubtedly strengthen the impact and coverage of utility "energy conserving home" programs.

I have three other comments on what is accepted design and construction practice in California, but they apply equally to commercial buildings so I shall wait until Section 5, below. First, I will briefly discuss California's standards for commercial buildings.

(3) Standards for non-residential ("commercial") buildings.

Since 1977, California has had Building Energy Performance Standards for non-residential buildings. They are based on ASHRAE's Standard 90-75, as calculated by our original Cal-ERDA computer program. New buildings that conform to the standards would use one-half to three-quarters as much energy as the "energy guzzlers" built in the ten or twelve years before 1973. But their first cost is typically no higher. This is because even though energy itself was cheap in the 1960's, the acres of glass and acres of lights that tended to be installed, greatly increased the need for expensive cooling systems. Thus, a return to rational buildings not only saved energy, but allowed considerable reductions in the initial cost of glass, lights, and air. Hence, builders have found that they can pay for the increased insulation and better control systems, and still come out ahead in first cost. This interesting conclusion was first reported in A.D. Little 1976, "Assessment of the Impact of ASHRAE Standard 90-75" (Reference 3).

Non-residential buildings do not depend very much on the climate, so there is little that is special about California buildings. Thus, I will delay my further comparison of existing buildings and BEPS buildings until Section 4 of this testimony.

(4) General Comments on California Building Standards

I conclude my discussion of California with three observations.

(A) Although, California has performance based standards, a computer is seldom used. Printed tables of sample conforming buildings and of trade-offs provide all of the information needed by most builders who want to design a conventional home or small building.

Computers are used only rarely, either by innovators or by teams designing large buildings, where the investment in modelling and optimizing performance is justified more by economics than by a desire to conform with energy budgets.

(B) Weighting factors for electricity. In formulating a building energy operating budget, there is always the question of whether to work in dollars or energy, and if in energy, then should electricity be measured at the building boundary or in resource units (i.e., in terms of fuel burned back at the power plant)?

To my mind, if it were not for inflation, it would be best to work in dollars. After all, there is no shortage of energy, only of cheap energy, and what we are ultimately trying to conserve is money. But prices inflate, and nobody has saluted the idea of indexed budgets for building energy costs, so I accept energy budgets as second best.

The question is, how do we add electricity to gas or oil? Assume that we have a gas meter reading Btu, and an electric meter reading kWh. We can convert kWh to electric resistance heat by multiplying by 3412 Btu/kWh. But we can also convert kWh to equivalent fuel burned back at the power plant by multiplying by 11,500 Btu burned per kWh sold. Which to use? 3412 for "site energy" or 11,500 for "resource energy," which is 3.37 times larger?

California has actually adopted an "Electric Resource Multiplier of 3.0" because it believes in conserving resource energy. So do I. But in addition, I introduce Table II to show that resource energy is closely related to my prime consideration — actual dollar price.

Table II: Comparisons of California Costs for Natural Gas and Electricity

	Gas	Electricity	
		Bldg. Boundary	Resource
Btu per kWh	-	3412	11,500
Average cost/kWh	-	$ 0.05	-
Average cost/MBtu	$5.00	$15.00	$4.50

If what we are really trying to conserve is money (i.e., to get the most comfortable buildings for the least cost), then Table II shows us that it is resource electricity that is most comparable in price to fuel. We see that, when measured in terms of resource units, electricity costs about the same as gas, whereas measured at the building boundary it is about 3-times more expensive. We see then that a multiplier of 3 (as adopted by California) can be thought of either as a resource-unit weighting factor or a price weighting factor. To me, it seems to be the most reasonable weight for electricity.

For BEPS, the Dept. of Energy proposes price-weighting, rather than resource weighting, and we have seen that the two are equivalent with one exception. The BEPS Notice of Proposed Rulemaking is not clear as to whether the weighting factor is to be adopted by each state or accepted nationally. I recommend that it be chosen for each state, and indeed that it could be specialized to individual utility districts where this makes a significant difference.

(C) California's enforcement and evaluation program is practically non-existent. Partly as a result of "Proposition 13" budget pressures on state and local governments, California has invested very little in training code officials; or in providing inspectors to verify that the buildings are built as designed. So far, I know of no comprehensive studies to measure the actual energy consumption of Title 24 buildings.

All this is unfortunate and unwise. By encouraging not only cheating, but indifference to fully complying with the standards, it wastes energy and money. It should surely not be used as a model for BEPS.

Nevertheless, I think that Title 24 has been much better than nothing, and I think that it shows that one can usefully mandate standards even before a good enforcement and evaluation program is in place.

June 4, 1980

III. BEPS FOR HOMES

In this section, I want to show where the proposed BEPS falls between current building practice and a true least-cost home.

Figure 1 compares the 1979 proposed (Medium Infiltration) BEPS with current practice, with strict (Lo-Infiltration) BEPS, and with a least-cost passive solar home. Later, Figure 2 will introduce data for existing homes in Colorado and Washington D.C. Figure 1 is taken from Reference 4.

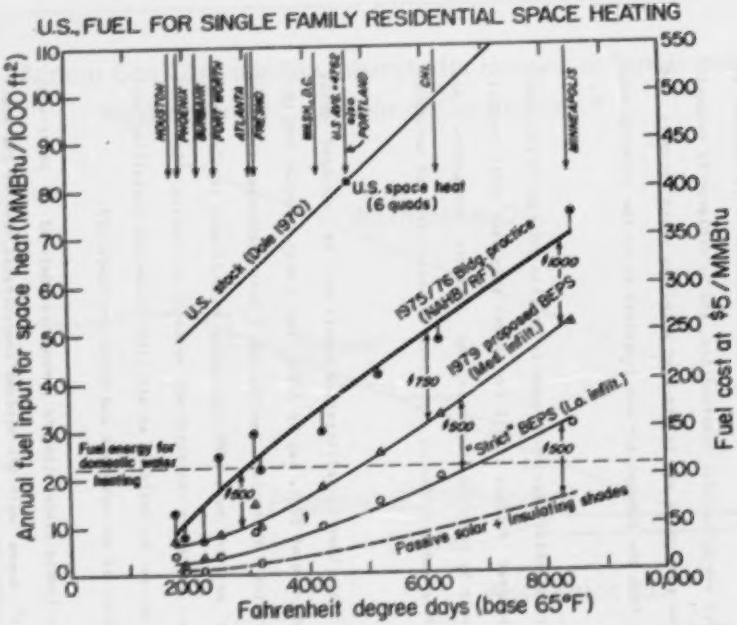
The weather gets colder as one reads to the right. The left vertical scale is annual fuel for space heat; the right vertical scale gives annual heating cost, assuming the fuel costs $5/Million Btu = $0.50/therm = only $0.70/gallon of heating oil.

The top line labelled U.S. Stock comes from a 1970 survey by Dole (Reference 5). Richard Ittelag of the American Gas Association tells us that between 1970 and 1978 weather-connected gas use for space heat went down 17% (Ref 6), and I would guess it's now down another 10%. Existing homes on the "Stock" line have an average rate of natural air infiltration of one air change per hour (1 ach).

The next line (our basis-line) shows estimate of 1975/76 building practise, made by the NAHB Research Foundation. These homes have more insulation, and reduced air infiltration (0.6 ach).

The next line is the 1979 proposed BEPS. The 10 city-points are least-cost calculations, keeping the infiltration unchanged at 0.6 ach but increasing insulation and going to triple glazing where it pays.

FIG. 1.



XBL 795-1396B

Fig. 1. Annual fuel input per 1000 ft.^{2} for space heat for a one-story ranch house, based on computer simulations for BEPS for 10 U.S. cities. The conversion from thermal load to fuel input was based on a seasonal furnace system efficiency of 0.7. Sources: BEPS Technical Support Documents and Ref. 1 of this paper.

The increased costs relative to 1975 practice, as estimated by DOE, are shown. They vary from $1000 for lots of insulation and triple glazing in Minneapolis, to $500 in Phoenix.

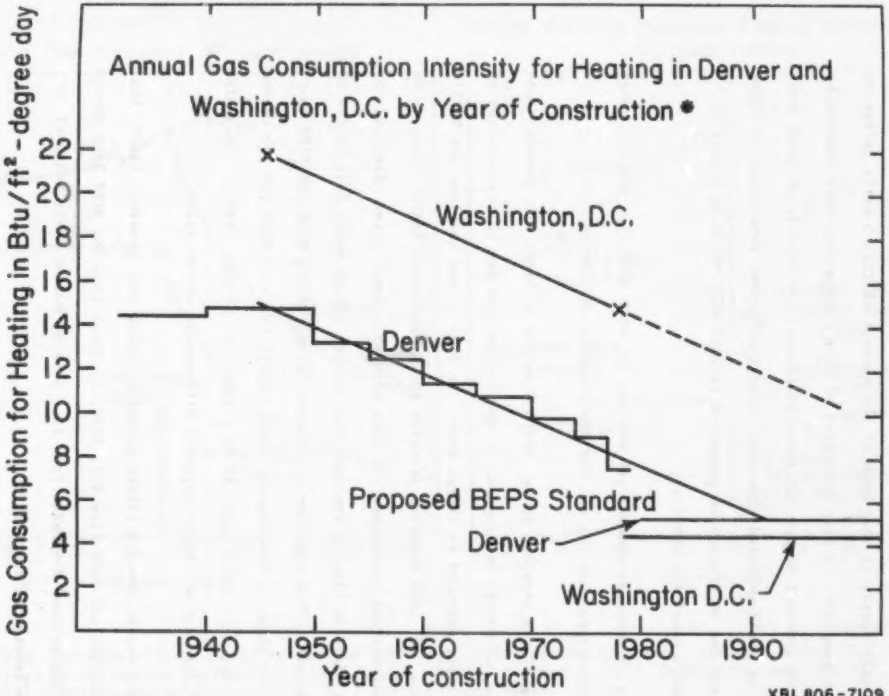
The nextline ("Strict BEPS") assumes that natural infiltration is reduced to 0.2 ach by careful construction, and is replaced by mechanical ventilation through an air to air heat exchanger which recovers 75% of the heat from the exhaust air and transfers it to the incoming supply.

Although residential heat exchangers to do this job can be purchased for a few hundred dollars retail (as shown) they have until recently been offered only by European, Canadian, and Japanese Companies. And the U.S. building industry has no experience in installing and maintaining them.

Hence DOE feels that Lo-Infiltration should not be required until the first revision of BEPS, say in 1985. But I want to point out that the Lo-Infiltration / Mechanical Ventilation / Heat Exchange trade-off is a cheaper way to meet BEPS than going to R-27 wall insulation or triple-glazing. Hence any innovator who wants to do better than BEPS can cheaply do so by building an air tight house and installing heat exchangers. This, is an important and lucrative trade-off.

Finally the lowest dashed line is a rough estimate of a least-cost "passive solar" house with its windows concentrated towards the south and equipped with insulting shades for use after sundown. We see that such homes cost only $2000 more than today's new homes, yet use less fuel than is used today to provide hot water! Clearly passive solar

FIG. 2



XBL 806-7109

Fig. 2. Gas consumption for heating (in Btu/ft.^{2}-degree-day) is shown for the Denver and Washington, D.C. areas by year of construction. The Denver data are taken from a 1978 consumption survey of over 6200 Public Service of Colorado customers. The Washington, D.C., data were provided by Washington Gas Light Co. for 1973 construction and pre-1973 construction. The pre-1973 stock is plotted for 1946, which is the weighted average year of construction for U.S. housing built before 1976. Proposed BEPS standards for Washington, D.C., and Denver are shown for comparison.

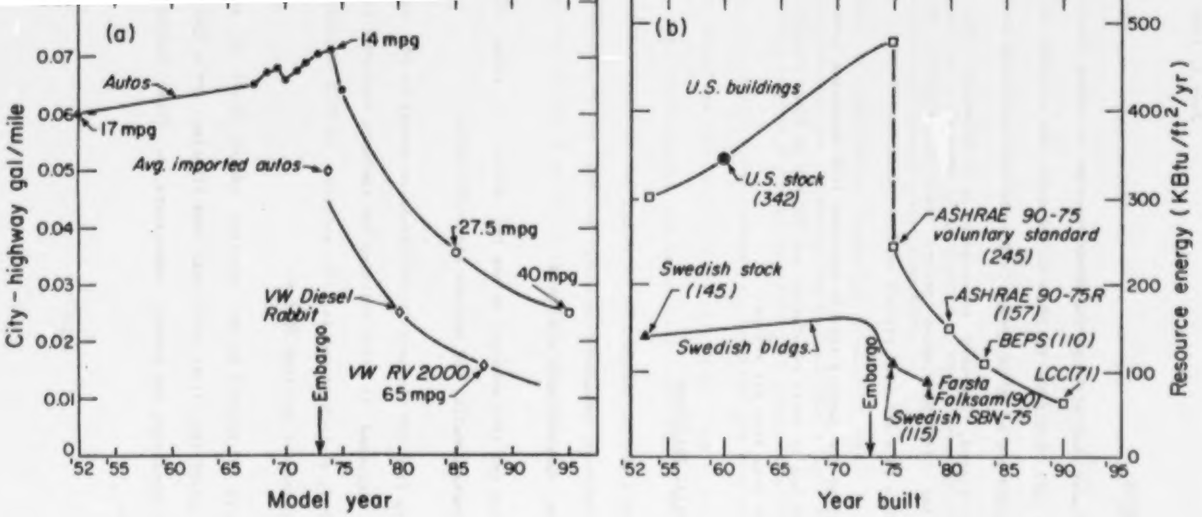
trade-offs will vie with lo-infiltration as builders learn to outperform BEPS!

My only regret is that much of the content of Fig. 1 still relies on computer programs. I have a version of this figure with dots representing a few low-cost energy efficient buildings, but clearly we need hundreds of well-measured low-cost energy-efficient demonstration homes only then can we proceed to mandate a revised BEPS which is closer to least-cost homes for Americans.

Fig. 2 compares metered gas heating use with BEPS, for Denver homes of various ages, and for old and new homes in Washington D.C.

Fig. 2 was provided by Dr. David Claridge of SERI. To permit comparison of Denver Washington, he has divided gas use by the coldness of the winter, measured in degree days. On Fig. 1, our baseline for NAHB's estimate of 1975 building practice shows Washington, Denver homes to be of equal thermal tightness. If this were so, then after dividing by degree days in Fig. 2, the data for the two cities would fall on top of one another. They sure don't. Denver agrees nicely with the NAHB survey. But shame on Washington, using nearly twice as much gas per degree day as Denver! There ought to be a law! I propose BEPS. (We also should find out why there regional differences are so large.)

Even Denver needs a little prodding, since the present trend will not overtake our BEPS line till 1990, by which time the BEPS line should have been revised downwards from its present "medium-tight" value of 5 to the "least-cost" value of 1.



XBL 806-1124

Fig. 3. U.S. Horsepower Race, Autos vs. Office Buildings, a 40-year Perspective. Sources: Autos: T.C. Austin, 1975, Society of Automotive Engineering Transactions, 750957; J. Pierce, 1975, Scientific American 232, 1 (January 1975). Office Buildings: References 1, 3, 4, 7 and 8 of this paper.

FIG. 3.

Uninsulated New Houses

We should note next that although the Denver average is coming down each year, there are still bad builders in Colorado, and probably in every state. I remind you of my paragraph in the introduction about the uninsulated single-glazed, low-cost homes going up in Lakewood. They correspond to the bad 1945 Washington point, under construction in Colorado today. This is a shameful rip-off of low-income home buyers.

Robert Hemphill of TVA reports that he surveyed 1000 Tennessee homes built in 1979, 20% had no attic insulation and 80% had no floor insulation. We need such data from all states.

IV BEPS for Commercial Buildings

Fig. 3(b) shown a 40-year perspective in energy use in office buildings. It shows the great reductions in energy use that can be achieved by increased prices, combined with standards.

Between 1952 and the 1973 embargo, we see the effect of acres of lights and glass curtain-walls, and massive air conditioning.

The sudden drop from 490 thousand Btu/ft^2 resource energy to 245 is what would have happened if 1975 building had suddenly conformed to ASHRAE Standard 90-75, as interpreted in 1975, according to 1975 customs of lighting and thermostat settings (Ref 4).

The next drop to 157 Btu/ft^2 is the (revised ASHRAE 90-75 R, as interpreted by AIA/RC (Ref 7) in 1979, with less lighting, and a thermostat "deadband" permitting the indoor temperature to float between reasonable limits.

The next point is BEPS (at 110), and finally we see the average of three calculations of a minimum life-cycle-cost (LCC), performance by AIA/RC (Ref 8). The LCC buildings are reported to be only \$2-3 (5 to 10% percent) more expensive per ft^2 than current practise!

Just as in the case of residential bldgs. it appears easy and cheap to achieve performance better than BEPS.

Fig. 3a shows similar trends for autos. I find it interesting, because gasoline use and energy use in commercial bldgs. both represent comparable amounts of energy (gasoline - 14 quads, commercial bldgs. = 10). It appears that commercial buildings are even more elastic in their energy use than cars. To get cars from 17 mpg to 65, we have to make them much smaller, and raise their first cost by 20%. But we can reduce the resource energy used per sq. ft of commercial buildings from 500,000 to 50,000 with almost no loss of amenity and an increase in first cost of only 5 to 10% of the first cost (ref. 8).

V. Political Reaction to BEPS

BEPS is really two actions taken at once, and failure to separate these two distinct purposes has resulted in much confusion. First, BEPS is an energy conservation standard: it requires that buildings use substantially less energy than at present when operated in normal fashion, at a savings in life-cycle cost to the building owner. Second, it is a performance standards, which regulates the actual amount of (predicted) energy use, rather than a particular method of building, so it allows much greater flexibility than most existing energy standards, which are prescriptive in nature.

Energy Performance standards are more difficult to enforce than the usual prescriptive standards, because they require predictions of energy performance given only building design information. There is no simple method available for making this prediction accurately. Thus enforcing to a pure performance standard is expensive and time-consuming. The few jurisdictions which offer performance standards as an option have found that less than 20% (and in many cases, less than 1%) of all building permit applicants attempt to meet the performance standard options. The overwhelming majority of applicants elect to conform to the prescriptive standard option.

This legitimate reluctance to get involved in actual performance calculations is at the root of much of the construction industry's opposition to BEPS. Statements by the NAHB and other organizations have highlighted the high cost of compliance to BEPS. Their costs are based on complying via the performance path. If a parallel prescriptive or workbook path is available, the grounds for this opposition disappear. ASHRAE recognized this in 1975 in its voluntary standard 90-75. It published 9 chapters of prescriptive rules but added Chapter 10 which permitted trading off features so as not to change the total energy budget. I applaud this wise parallel approach.

Much of the controversy surrounding BEPS appears to us to be a response to DOE's emphasis in the NOPR on only the performance path. While it is important to have a performance standard available to those builders who want to use it, it is unrealistic to think that more than a handful of builders will use the performance standard (which has already been computed). This prescriptive equivalent is easy to comply with, both for the builder and for the enforcement agency.

Even if the builder chooses to go the performance route, the prescriptive equivalent standard gives him a much better idea of the starting point, as opposed to a abstract energy budget.

That is, if a builder sees that by using R-38 ceiling insulation, R-19 wall insulation, R-19 crawlspace insulation, and double-glazing, with a 78% efficient furnace with stack damper and spark ignition, he can get some idea of where to start if he wants to substitute some features (e.g., thicker ceiling and floor insulation) for others (e.g., double-glazing and R-11 walls). If he only sees an energy budget, then he has to attempt to comply by trial and error, using a very complex analytical model.

While DOE has been doing some research on simplified building models, it has not directed much effort at trying to produce simple "cookbooks" that give the builder a starting point (the prescriptive equivalent) and some simple rules for trade-offs. These cookbooks could be produced relatively easily for a city for which analysis has been done (there will be 33 of them -- there are 10 now), and extensions to other areas would be easy.

With the prescriptive standard option and some simple trade-off rules, BEPS would be easy to enforce. They would accomplish a major savings in energy use compared to current building practice -- perhaps as much as 50% -- and would help builders begin to produce houses which minimize life-cycle energy costs.

VI. RECOMMENDATIONS FOR IMPLEMENTING BEPS.

As outlined above, California (and other states) have by now accumulated several years of experience with building standards and related programs. As with any new endeavor, not every step has been a smooth one, but there have been opportunities to learn from mistakes and correct them. And, overall, we are beginning to see significant changes in the attention paid to energy by the buildings industry in the design, construction, and marketing of new homes and commercial buildings. BEPS, properly implemented, can accelerate this trend.

Let me first list my four basic recommendations for implementing BEPS, and then discuss each of them briefly:

(A) Staged implementation- The Federal government should proceed now with a staged implementation of BEPS, in a limited number of pilot states that are ready to adopt building standards or to upgrade existing ones. These states would receive special financial assistance and other incentives for participating. Eventually, of course every state would have to implement BEPS or a equivalent program.

(B) State and local innovation- of possible innovative approaches (including non -mandatory programs, alone or in conjunction with standards) that might be implemented at the state, local, or utility levels to save at least as much energy in new buildings as BEPS. These alternative approaches should be not only allowed, but actively encouraged (and closely monitored) during the initial stages of BEPS implementation. This may require changes in both the proposed DOE regulations, and in federal law.

(C) Training, monitoring and evaluation, new technologies- DOE should immediately prepare budget results for substantial increases in the level of federal support for BEPS-related training, program monitoring and evaluation, and development of advances conservation technologies in new buildings.

(D) Long-range standards- as soon as practicable, there should be added to BEPS a set of federally-adopted long-range (5 to 10 year) target standards, similar to those adopted by Congress for auto efficiency. By providing a more stable regulatory climate, large-range standards can help to stimulate new technologies, institutional change, and greater levels of efficiency.

Staged Implementation

I have already argued that the levels of energy efficiency proposed in the BEPS rule are not only readily achievable, but in many cases are already being met or surpassed by designers and builders who are leading their industry in the direction of energy-awareness. The rules themselves are unnecessarily complex, but not impossibly so. To some extent the complexity is needed to provide flexibility to the industry and its customers.

At the same time, those of us who support the BEPS concept fully recognize the practical problems of achieving immediate nationwide compliance. The need to inform and educate hundreds of thousands of designers, builders construction tradespeople, and inspectors will require a major, sustained effort, and far more resources than appear to be currently allocated (an issue to which I will return in a moment.

While implementing BEPS is a formidable task it is by no means an unmanageable one--my main point is that it will be more manageable if we begin the process on a selective basis, rather than everywhere at once. Those states (or communities within states) that are best prepared and most receptive to BEPS have shown that there are a number of still unanswered or partly answered questions about the technical and administrative aspects of BEPS. The best way to resolve most of these is not to analyze them further, in the abstract, but to observe actual BEPS programs in action. By establishing pilot programs and carefully watching their progress to determine what works--or does not work--under which circumstances, it is likely that implementation can proceed for more rapidly, more effectively, and at a lower cost in the remaining states.

The use of pilot programs was the approach that Congress wisely chose with the Energy Extension Service. There is even stronger justification, given the scale of private and public investment involved, for doing the same with BEPS.

I would recommend that up to ten states, and perhaps an equal number of local jurisdictions, be selected on a competitive basis as BEPS demonstration sites, for a two-year period. During this time, the same level of Federal funding and technical assistance that would otherwise have been available for BEPS implementation nationwide should be concentrated within these demonstration areas--with increased emphasis on the funding of training, monitoring, and evaluation activities, as noted below. After this initial two-year period, Congress should review the results of these pilots programs as well as circumstances in the remaining states, to determine whether nationwide implementation of BEPS should proceed, or whether there should be a second more extensive round of pilot programs.

B. State and Local Innovations

As presently written, the proposed BEPS rule allows states or local jurisdictions to comply with the standards by certifying their own building codes as equivalent to the federal performance budgets. However, nothing in the proposed BEPS rule, or in DOE's discussion of alternatives for an "implementation," would allow states, localities, or utilitiex to demonstrate conformance with the intent of BEPS --improved energy efficiency in new buildings--using approaches other than building codes. Nor are these provisions for innovative combinations of (possibly less stringent) codes plus market incentives, to achieve the same impact.

The forthcoming rule on BEPS implementation should explicitly provide for such innovative alternatives, at least during the two-year pilot stage, even if this requires statutory changes by Congress.

Many states will probably choose to implement BEPS using building codes, but we should not consider other, non-code programs as simply a theoretical alternative. For example, the voluntary "conservation home program," mentioned earlier, now being implemented by PG&E and other California utilities (and soon to be expanded through a California PUC ruling on gas and electricity service extension rules) appears to be achieving good enough savings under BEPS.

To cite just a few examples of possible alternative implementation approaches" other than building codes:

- "Performance warranties" by designers and builders.

- Restructuring of gas and electric rates for new buildings (combined with improved consumer feedback on energy usage and costs) to provide steep penalties for usage in excess of BEPS levels, but substantial dollar savings for reducing consumption below these levels.

- Financial incentives to builders to meet and exceed efficiency levels, whether through California-style service extension rules, tax credits, or other mechanisms.

- Use of a "market-mix" approach to performance levels, comparable to the automobile fleet-average standards, but applied on a subdivision-wide basis to determine a builder's compliance with BEPS.

- Allowing builders to use subdivision layout and community design techniques to achieve additional energy savings (perhaps trading off transportation and "micro-climate" energy savings against energy usage within individual structures).

Encouraging innovation at the state and local levels during the two year pilot phase may also provide better opportunities to broaden BEPS along several of the dimensions that were deferred or treated only partially in DOE's initial analysis. Examples include:

- Stricter performance levels, at last for selected climate zones, political jurisdictions, or building types.

- Consideration of electrical load management, to avoid as much as possible adding to summer or winter peak period electrical demand. (Alternatively, a state with a less successful program could remain in compliance with BEPS if its program evaluation identified the changes that needed to be made. The intent, of course, is to avoid creating an incentive for all evaluations to come up with only positive findings!)

C. Training, Monitoring and Evaluation, and New Technologies.

Let's glance back at Fig. 1 or Table I and compare the extra cost and the annual savings of a BEPS house compared with its neighbor built according to current practice. The BEPS house will cost about an additional $1,000 but (averaged over U.S. weather) it will save about $175/year utility bills, so that the $1000 will be paid back in about 7 years... the typical term of occupancy of the first owner. To protect the $1000 investment (and the $1000 return-on-investment through savings) we would do well to spend a few percent of it on inspection to assure compliance. Also one or two percent of the $1000/home should go to state programs for BEPS evaluation. So I recommend a total of $50/home for "monitoring". Restated on a nationwide basis, if we build 1.5 million new homes yearly, we ought to spend $75 million on inspection and evaluation of residences. If we include commercial buildings we should think of $100 million.

This brings us to more tens of millions of dollars which are needed for the education and training of architects, engineers, builders, craftsmen, inspectors, specialist in indoor air quality, and code officials. These professionals all need help before the can effectively turn out energy-efficient buildings, both residential and commercial. In the 1950's the U.S. profitted by the National Defense Education Act; it would profit in the 1980's by a National Energy Education Act.

In we are to create advanced, innovative, efficient buildings, we need many new efficient products, motors, windows, advanced heat exchangers which transfer heat and pure water vapor, thermal storage systems, controls of all sorts, integrated appliances, etc. This is a engineering challenge which requires the training of more engineers in the end-use of energy.

D. Long-range Standards

Eventually, BEPS should evolve toward a set of long-range standards, adopted well in advance (5-10 years) of the date they are to become effective, and regularly reviewed and updated. As with federal automobile standards, this will provide the building industry with sufficient advance guidance to both encourage (through market pressures), and allow the time for, innovation--in products, design practices, and construction techniques. Long-range standards ca be much stricter than those that must take effect immediately. As a result, over time that can help to raise the level of the "best practice" in the industry, not merely eliminate the worst.

In the interim, after such long-range standards are adopted but before they become a mandatory, federal or state financial incentives and education of the building industry and the buying public can do a great deal to encourage earlier, voluntary implementation.

In California, the Energy Commission is already moving in this direction in considering changes to strengthen its existing buildng standards, with the active interest and participation of the state's building industry. From the industrys perspective, tougher building standards are a better-than fair exchange for the increased predictability that long-range standards provide.

Acknowledgements

I want to thank Jeff Harris of the California Energy Comm. and David Goldstein and Mark Levine of LBL for their contributions and suggestions.

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Senator JOHNSTON. Thank you very much.
Dr. Levine.

STATEMENT OF DR. MARK D. LEVINE, ENERGY AND ENVIRONMENT DIVISION, LAWRENCE BERKELEY LABORATORY, BERKELEY, CALIF.

Dr. LEVINE. Thank you very much. Let me introduce myself very quickly. I have been doing energy policy for the last 8 years, first in the Ford Foundation energy policy project, then at Stanford Research Institute and at the Lawrence Berkeley Laboratory.

I studied a whole range of policies, including one that I think you are particularly interested in right now—the tax and rebate system for gasoline. I guess we did an analysis and recommended to Congress through OTA that they very seriously consider that policy as the best way of dealing with potential oil shortages.

For the last more than 2 years I have been program director in three program areas of LBL. One is building energy performance standards where we focused on residential standards. The other is the appliance efficiency standards, also called consumer products energy efficiency standards, that will be promulgated by DOE shortly, and a third area is just overall economic analysis relating to energy conservation policy.

I would like to make clear that I am testifying based on the expertise I have developed in leading these activities. I hope this expertise will be valuable to you. I will be expressing my own opinions based on this experience and not those of either DOE or LBL. I have 5 minutes, and I would like to make the most of them. Most of the issues have been raised already. Where they have been raised, I will summarize very briefly my position and reasons for it. Where there is some new point I will go into it in a little more detail.

The first is the issue that was really the first question that Senator Johnston raised having to do with completion of BEPS.

I maintain, No. 1, that BEPS as it stands in the Notice of Proposed Rulemaking is indeed very complex. I sympathize with various organizations and groups that have tried to understand it and have helped in analyzing it because it was very difficult.

On the other hand, I maintain very strongly, one, that it need not be complex, that it can in fact be relatively simple, and No. 2, and this is an important point, I believe that DOE is effectively making BEPS into a program that is far simpler than we have seen it today.

The second point I would like to address has to do with the stringency of the budget. Actually I think Art summarized that very well on his last slide, or I'm sorry, in his first two slides where he pointed out the budget was tighter than building practice, and indeed significantly tighter. It was estimated to be 30 or 40 percent tighter than 1975 and 1976 practice, but not nearly as tight as one could go were it possible to bring about substantial innovation in the building industry.

One of the things I will talk about later is how BEPS in fact could promote innovation in the building industry. I think that is crucial. I think if BEPS works to educate people, home builders, home buyers, and all the rest of us, and I think it will educate people, I think one of the ways it will do so is the controversy that has come up over BEPS and weighting factors and everything else forces people to figure out, to try and figure out what is going on, and I think that may be one of the most important impacts of BEPS overall.

A third point has to do with the role of the marketplace. I have done some analysis on the most recent National Association of Home Builders (NAHB) data on what the marketplace is doing and have concluded that the marketplace isn't very close to BEPS right now and hasn't gotten very close since 1975 and 1976.

The last data that were available, I think looking at the marketplace leads one to the conclusion that the residential sector——

Senator JOHNSTON. Could you sum up very quickly, Dr. Levine, particularly on the weighting factors? We do have a big agenda left.

Dr. LEVINE. OK. Let me summarize, if you can bear with me, I will start with weighting factors because that has been such a hot topic.

There is a wide perception, and we have heard it here today, that weighting factors discriminate against the use of electricity compared with other fuels for space heating. As a result, it is often maintained BEPS represents a fuels policy rather than an attempt to put insulation in a house that favors the use of two fuel types, oil and gas, over that of electricity for space heating.

These perceptions are in fact false for single family residential buildings where different design energy budgets are presented for gas, oil, and electricity.

Senator JOHNSTON. Let me ask this. Wouldn't you have two homes, exactly the same size, exactly the same orientation of the Sun, with one requiring in effect more strict insulation than the other, depending on which fuel they use?

Dr. LEVINE. You would, and it is not because of weighting factors. Let me explain that. This is not understood.

I have read a lot of public testimony. It doesn't matter if you have weighting factors as far as the insulation requirements that BEPS promotes in houses.

The reason that you have more insulation in the electrically heated house is because electricity is more expensive with or without weighting factors. The methodology used to develop this standard——

Senator JOHNSTON. It is weighted by price?

Dr. LEVINE. No. The methodology used to develop the standard was to ask the question what makes economic sense in a given region, and the answer is in almost every region of the country it makes more sense to use more insulation for electrically heated houses than gas heated houses because electricity costs three times as much, and if we threw away the weighting factors and only used an economic assessment but expressed the design energy budget, whatever unit you want, you would find out that in almost every region of the country it makes more sense to use more insulation for electric houses than gas houses.

Senator JOHNSTON. I think I understand this issue. Let's move on.

Senator **Bumpers**. Well, I don't. Let me ask one question, Mr. Chairman. That is what difference does it make? We are trying to save energy, be it electricity or gas. Now if I were building an electrically heated home, I would take that cost into consideration and I would probably put more insulation in than I otherwise would, but that ought probably be a consumer choice, should it not, because it is an economic decision, not an energy decision with him?

Dr. **Levine**. Let me comment on that. The regulation has come about because Congress in the legislation itself noted that the marketplace wasn't doing all it should, so the existence of a proposed regulation states that it is Congress judgment that the market isn't working quite right. Therefore, the Government has taken the authority, the responsibility for telling people what a good response as far as energy conservation in houses is.

Now I think that if the Government is going to promulgate a regulation in this area, and I believe it is needed, that it wants to do it in a way as consistent with the marketplace as possible, and because DOE is required to give energy budget numbers, it seems to me they ought to give budget numbers that reflect the economics of the situation so as to produce the least distortion in the marketplace that is possible.

Senator **Bumpers**. Mr. Chairman, we can debate the propriety of this.

Senator **Metzenbaum**. I want to follow up Senator Bumpers' question. What you are saying is that in a weighting factor there ought to be more insulation in electrical homes than there is in homes heated by gas because there are economic considerations? Am I correct?

Dr. **Levine**. Yes.

Dr. **Rosenfeld**. There is a word being used wrong. It is really causing some confusion. Let me make a very strong statement if I may.

If there were not a house with two sources of juice going in, the word weighting factor would not come in. If you have an electrically heated house, then BEPS calculates how to minimize your costs. It recommends certain insulation and the word weighting factor never enters.

If you had a house which is only gas heated, the word weighting factor would never enter. They would have different recommended insulations.

The only time weighting factor ever comes in is when you try to heat and cool the house at the same time.

Senator **Metzenbaum**. Let me be the devil's advocate for a moment. It seems to me there ought to be more insulation required in gas heated homes because there is a finite supply of gas, but with respect to electrically heated homes we normally do that either by hydro power, we do it by coal or we do it by nuclear. There is not nearly the shortage certainly as the first and the third or what might be with respect to hydro, but the fact is that the one resource that we know is limited is natural gas and how can you, therefore, say that the weighting factors ought to be on the side of greater insulation for the electrically heated home?

Dr. **Levine**. Let me answer the question this way. I think that the price of the fuel should reflect its value, its scarcity, its other values to the Nation. I think that it is within Congress domain and the administration's to influence the price of fuels so that they do as well as possible reflect present and future values of fuels.

I think that in promulgating the standards it is appropriate to promulgate them based on information in the pricing system and information in Federal policy as to the relative value to the Nation of those fuels.

I think furthermore that the weighting factors as used reflected both price and Congress statement about the additional value of oil and gas to the Nation.

I think the weighting factors actually concerning what would occur in the market situation favor not oil and gas but were actually designed to be relatively more favorable to electricity in response to congressional position that oil and gas are underpriced in the marketplace.

Senator **Johnston**. Let me ask you this. What difference is there between air-conditioning and heating insofar as insulation is concerned?

Dr. **Levine**. That is on a different subject. Insulation tends to save you more heating energy than cooling energy.

Senator **Johnston**. The heat rises so I guess you would have to have more ceiling insulation? In other words, if a house is well insulated for heating, is it also ergo well insulated for cooling?

Dr. **Levine**. In most climates a house that is well insulated for heating will also be well insulated for cooling.

Senator **Johnston**. It is pretty well the same steps taken for each?

Dr. **Levine**. Pretty much the same steps taken for each, that's right. On the question of—one last comment—saving oil and gas versus electricity, I think it is important to realize that peaking electricity comes from oil and gas, and your air-conditioners are run almost entirely on peaking electricity, and if you do an evaluation of the oil and gas required to run electric air-conditioners, you will find out that BEPS as it is now set will save lots of oil and gas by saving peak electricity. That is I think an important consideration.

I would like to move on and summarize.

Senator **Johnston**. Summarize very quickly. We are falling behind.

Dr. **Levine**. I will do that. I have one additional point, and I would like to restate one point. The first point that I am restating is that I think BEPS can be simple. I have got some charts with me that there isn't time to go over, but we are presenting some information to DOE which I think will help them make it simple, and then I would like to comment on the BEPS schedule.

It looks like BEPS is going to be delayed. I think any lengthy delay in BEPS is unfortunate, but there are probably good reasons to have the delay that has been talked about today.

However, I think that a delay in BEPS, approved by Congress, simply as a delay may well be interpreted by the building community as the lack of full support by Congress for its ECPA legislation in the building energy performance standards.

That raises a dilemma if in fact you support BEPS because you think it will save a lot of energy in buildings, but you know it is complicated and has to be made simpler, you are going to vote for a delay, but how do you do that without giving the message to the community that that delay is not meant to be indefinite?

My suggestion in this regard is as follows. I recommend that in any legislation that supports a delay of BEPS that Congress at the same time indicate forcefully that they would encourage States and other jurisdictions to voluntarily implement BEPS at the earliest possible time even before DOE has completed their notice of final rulemaking, and I recommend further that such a statement be accompanied by proof that Congress means it, simply that Congress allocates money to the Department of Energy which can be given to States and localities that are prepared to volunteer to implement BEPS.

My last recommendation is that they if they do this, we monitor that process to find out how well it is working so that when BEPS really comes into play in a big way throughout the Nation, we know a lot about it.

Senator **Metzenbaum**. Do you see any practical way instead of just changing the date to have some phasing-in program? Is that a realistic approach?

Dr. **Levine**. I think it is realistic, and I think one effective way of doing that is to say here is a pot of money that Congress has made available and those States and localities that indicate they want to be first on the block, those places that think they can do it are entitled to some money to help them set up a process whereby they really can do it, and if we include in that money for an effective monitoring scheme, then we will have learned from that process what it takes to do BEPS. So my answer to your question is yes indeed, I think there is a phased-in approach that is possible and I think it should be done, and I think Congress can help make it happen.

[The prepared statement of Dr. Levine follows:]

TESTIMONY ON THE DEPARTMENT OF ENERGY BUILDING ENERGY PERFORMANCE STANDARDS BEFORE THE SENATE SUB-COMMITTEE ON ENERGY REGULATION OF THE COMMITTEE ON ENERGY AND NATURAL RESOURCES

Prepared by:
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INTRODUCTION

I am delighted to have the opportunity to testify before this Committee of Congress on the Department of Energy's (DOE's) proposed Building Energy Performance Standards (BEPS). Considering the importance to the Nation of energy conservation, the large potential for reducing the growth in energy demand in buildings (that presently consume 35% of total U.S. energy), the long time period over which new buildings will consume energy, and the range and intensity of public interest in BEPS, I particularly welcome the chance to present my views in an effort to clarify many of the issues raised by DOE's proposed standards.

Let me first introduce myself. For the past eight years, I have worked full time performing research on economic and policy issues concerning energy. I was Staff Scientist at the Ford Foundation Energy Policy Project during 1972 and 1973. I was a Senior Energy Policy Analyst at SRI International from 1974 through 1978. During the past two years at Lawrence Berkeley Laboratory (LBL) I have been Principal

Investigator responsible for managing programs in three areas: Building Energy Performance Standards, Appliance Efficiency Performance Standards, and Economic Analysis of Energy Conservation Policy. In this capacity, I have led the LBL effort in simulating the energy use of residencial buildings, in analyzing the economics of energy conservation measures in residences, in preparing analyses of alternative residential energy budget choices for DOE in setting the BEPS levels, and in performing various economic analyses related to building energy conservation policies. I hope that the expertise I have developed in performing this work will be useful to this committee.

I wish to make clear that I am representing only my own views in this testimony. I represent neither LBL nor DOE in my statements today. Because most of my expertise is in residential building energy and economic analysis, most of my comments will focus on this area. However, many of my comments will be pertinent to commercial buildings as well.

I will discuss the following issues in this testimony:

1. The Complexity of BEPS
2. Stringency of the Proposed Design Energy Budgets
3. The Role of the Marketplace and the Need for Standards
4. The Use of DOE's Proposed Weighting Factors
5. The BEPS Schedule

My major points on each of these issues are:

- BEPS does not need to be complicated. DOE has not yet accomplished the goal of making BEPS simple, but they are, in my judgment, moving effectively in this direction.

- The proposed Design Energy Budgets are set at a level that is achievable by builders. The Budgets could be much tighter if the building industry were able to take full advantage of a wide variety of innovative energy conservation measures and passive solar design.

- Home buyers have demanded, and builders have built, houses with more energy conservation, in response to high and rising energy prices. Nonetheless, the vast majority of buildings constructed today use far more energy than is necessary or economically desirable. BEPS does require significantly more energy conservation than is presently used in buildings.

- DOE's proposed weighting factors have been widely misunderstood by numerous groups. The weighting factors do not discriminate against electricity use in single family residential buildings. Rather, the higher price of electricity is responsible for the tighter standards for electrically heated houses. The weighting factors are, in my judgment, conceptually sound. However, their objective--to encourage consumers to use economic criteria in their choice of energy conservation measures--may possibly be achieved by simpler means that do not rely on weighting factors.

- BEPS should be delayed as little as possible. I believe that a delay of about a year may be needed to assure that BEPS is understandable to the building community and to clarify some technical issues. However, if Congress does vote for a delay, I recommend that their support for the BEPS concept be made clear. One way of doing this is to provide money to states that volunteer to implement BEPS before it has become final. Such a program would provide valuable data on the ability of states to implement BEPS.

DISCUSSION

The complexity of BEPS and the Dilemma of Performance Standards

In promulgating BEPS, Congress required that a performance standard be used to achieve energy conservation in new buildings. A performance standard is one in which a goal is established (eg., an energy budget level) but the means to achieve the goal is left up to the individual. A performance standard, if it can be implemented effectively, allows the building designer the maximum flexibility in meeting the defined goal.

DOE has adhered to the performance approach in its development of BEPS by publishing Design Energy Budgets for different building types in different climates in its Notice of Proposed Rulemaking. DOE has adhered to the performance approach in its development of BEPS by publishing in its November, 1979 Notice of Proposed Rulemaking Design Energy Budgets for different building types in different climates. Unfortunately, the Design Energy Budget does not by itself provide the average building designer, builder, engineer, or building code official sufficient information to know what must be done to comply with BEPS. This is because the Design Energy Budget is an abstract number of Btus per square foot per year; the builders, architects, and code officials want to know the specific measures that are required to achieve this number. Furthermore, from my experience, the building community wants to obtain this information without performing complex and cumbersome calculations.

This explains the dilemma of a performance approach to building energy standards: The very factors that cause performance standards to be flexible--the ability of the building designer to choose his methods to comply with the standard--also tend to increase their complexity.

How is this dilemma to be resolved? How can BEPS be made simple? In my opinion this is the central BEPS issue at this time. There are at least three ways of achieving this for residential buildings. They are:

1. Sets of Prescriptive Standards,
2. Simple techniques for trading off energy conservation measures against each other and against building energy designs, and

3. Computer chips for hand-held calculators.

Each of these approaches has advantages and disadvantages. All three are useful in providing different segments of the building community information to achieve the objectives of BEPS. The first is required for the vast majority of builders, designers, and engineers who want to comply with BEPS in the simplest way possible. It provides a specification (or a few specifications) that allow certainty that the standard is met. This approach is the same as a prescriptive one, except that several prescriptions are given that may be followed.

Work on this first approach was completed for ten cities for residential buildings before the Notice of Proposed Rulemaking was released. Six illustrations were provided--for electric and gas heating in three cities--in the NOPR. Table 1 illustrates the first approach (showing multiple ways of meeting BEPS with prescriptive standards) for Chicago. This multiple prescriptive approach is very simple to implement. However, under this approach, the building designer has relatively few choices of conservation options to meet BEPS. Furthermore, certain features of the building design may not easily be altered if only the multiple prescriptive approach is used. For example, this approach provides little guidance on how to meet BEPS if a house is designed with a large amount of window area. The multiple prescriptive approach is likely to be most widely used for the large majority of relatively standardized houses.

The second approach involving the use of trade off curves is likely to appeal to the designer who is interested in having a variety of choices for meeting BEPS. The designer may wish to choose a method of

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TABLE 1

THREE SETS OF PRESCRIPTIVE APPROACHES TO MEET BEPS FOR SINGLE-FAMILY HOUSES IN CHICAGO, ILLIONIS

GAS HEATED HOUSES

1. AVERAGE WINDOW AREA AND DISTRIBUTION;[a] TRIPLE GLAZING,[b] R-38 CEILING AND R-19 WALL INSULATION.

2. WINDOWS REDISTRIBUTED SO THAT SOUTH FACING WINDOW AREA INCREASED BY 75%, AND EAST, WEST AND NORTH FACING WINDOW AREA DECREASED BY 25%; DOUBLE GLAZING, R-38 CEILING AND R-19 WALL INSULATION.

3. ACTIVE SOLAR DOMESTIC WATER HEATING SYSTEM;[c] DOUBLE GLAZING, R-38 CEILING AND R-19 WALL INSULATION.

NOTES:

[a] The average window area is 15% of total floor area. The windows are distributed equally among the exterior walls.

[b] Double glazing plus storm windows can substitute for triple glazing with little change in the Design Energy Consumption of the house.

[c] The active solar domestic water system is assumed to supply 60% of the domestic hot water in a 1500 square foot house for the purpose of this illustration.

TABLE 1 (CONTINUED)

ELECTRIC HEATED HOUSES

1. AVERAGE WINDOW AREA AND DISTRIBUTION;[a] TRIPLE GLAZING,[b] R-38 CEILING AND R-25 WALL INSULATION; HEATING SUPPLIED BY A HEAT PUMP.
2. WINDOWS REDISTRIBUTED SO THAT SOUTH FACING WINDOW AREA INCREASED BY 36%, AND EAST, WEST AND NORTH FACING WINDOW AREA DECREASED BY 12%; TRIPLE GLAZING, R-38 CEILING AND R-19 WALL INSULATION; HEATING SUPPLIED BY HEAT PUMP.
3. ACTIVE SOLAR DIMESTIC WATER HEATING SYSTEM;[c] R-38 CEILING AND R-25 WALL INSULATION; HEATING SUPPLIED BY ELECTRIC RESISTANCE.

NOTES:

[a] The average window area is 15% of total floor area. The windows are distributed equally among the exterior walls.

[b] Double glazing plus storm windows can substitute for triple glazing with little change in the Design Energy Consumption of the house.

[c] The active solar domestic water system is assumed to supply 60% of the domestic hot water in a 1500 square foot house for the purpose of this illustration.

compliance that is less expensive than any of the prescriptive approaches. He may wish to accomodate some particular design objectives of his client not related in order to energy conservation, to take advantage of unique characteristics of the environment around the building; or he may desire to apply some innovative energy conservation measures as a means of selling the house. The approach is similar in many ways to that originated by the National Association of Homebuilders in developing their Thermal Performance Guidelines. (Mr. Ivan Wohlworth, who is closely associated with the NAHB, provided early assistance and support for the effort.) LBL will shortly provide DOE with a preliminary set of figures and tables with a description of the method of calculating tradeoffs among different sets of conservation measures to achieve BEPS in single family houses. After DOE's review, the approach will be tested with architects, builders, and building code officials and modified to make it as understandable to this community as possible.

The third method--use of a programmable calculator with a BEPS chip--is the most flexible (and probably the most difficult) of the three. In this approach, the designer would punch into the programmable calculator a series of numbers that describe the energy using and conserving characteristics of the building. For example, the inputs for a house might be the R-value of the ceilings, walls, and floor, the window area, the orientation of the house, the heated area of the house, the efficiency and size of the furnace and air conditioner, weather data for the location of construction and a few other parameters. This information would be used to calculate a Design Energy Consumption which could be compared directly with DOE's Design Energy Budget to determine if the building complies with BEPS. If the Design Energy Consumption calculated in this manner is higher than the Design Energy Budget, then the designer would have to modify some of the energy conservation features of the building in order to comply with BEPS. If the Design Energy Consumption is less than or equal to the Design Energy Budget, then the building is known to be in compliance with BEPS.

The third method is likely to appeal to the same designers who use the tradeoff curves of the second approach. However, the third method is in principle able to treat a wider variety of energy conservation options than the other two. If the programmable calculator chip is made widely available at a reasonable price and if it is easy to use to describe a variety of different energy conservation and building design options, then it may eventually come into widespread use among architects. I believe that the first two approaches will see much more widespread application, especially during the early years of implementation.

The development of a simple computer program not requiring a large mainframe computer is under development at the National Bureau of Standards. I am informed that the work is on schedule and will be available as a research tool this year.

In conclusion, I think that (1) BEPS can be made relatively simple to the building community, (2) DOE is well on the way to accomplishing this objective, and (3) the achievement of this goal is the single most important step to communicate BEPS to the building community.

The Stringency of the Proposed Design Energy Budgets

The Design Energy Budgets for single family houses were derived by evaluating the energy use of a building in which energy conservation measures were added in decreasing order of cost effectiveness. The Budget was set at that point at which the cost of adding a conservation measure was estimated to be greater than the benefit achieved by reduced fuel costs. Benefits and costs of the energy conservation measures over the lifetime of the mortgage were brought back to the present so that they could be compared.

Three important aspects of this methodology and its results need to be noted:

1. The energy use of the house was evaluated using a complex computer code (DOE-2). This computer program was used because it is able to perform hourly simulations of the heating and cooling requirements of a building over an entire year. Although such a sophisticated tool is needed to set the Design Energy Budget levels, it is not necessary for anyone to use DOE-2 to determine compliance of single family residential buildings This point has been widely misunderstood by many of the respondents in the public testimony. It is essential to keep this in mind in evaluating BEPS.

2. Only those energy conservation measures that are in widespread use in this country were included in the determination of the Design Energy Budgets. This means that no Design Energy Budget was set so tight that it could not be met by currently available technology. Thus, the most stringent conservation measure for the attic was taken to be R-38 insulation. R-24 insulation was the most stringent measure for the wall. The limit on number of glazings in the window was taken to be three. Innovative energy conservation measures were not included among those measures used to determine the Design Energy Budget. Thus the designer is required to use only those conservation measures well known to builders to comply with BEPS; however he may obtain credit for non-traditional measures as well.

3. There has been some public comment about the difficulty of meeting BEPS in selected climates, based on some computer studies of regions that were not analyzed in detail for the Notice of Proposed Rulemaking. Our investigations have shown that this results from extrapolating the Design Energy Budgets from only ten cities against the known weather data in different urban areas throughout

> the country. This regression is probably an adequate approach to the problem, but it does fail in a few locations. This technical difficulty will, I believe, be removed when the analysis is extended to additional locations. We are presently performing this extension of the study to 22 added locations. An alternative solution to the problem may be achieved by extrapolations of the prescriptive equivalent of BEPS rather than the Design Energy Budget to different regions.

Based on the method of approach that was used to develop the Design Energy Budgets for single family houses, the numerical results of the calculations, the economic analysis performed on these results and reported in BEPS Technical Support Document 8, and a consideration of much of the body of public comments on BEPS, I am led to the following conclusions about the stringency of the Budgets:

- The budgets can be achieved in all locations using available energy conservation measures.
- Complying with BEPS will require almost all builders to use more energy conservation than they are accustomed to.
- The Design Energy Budgets chosen for single family residences make good economic sense. The added first cost to the house because of increased levels of energy conservation are paid back to the home owner in 1 to 10 years in most locations at current and projected energy prices. If, as now seems likely, energy prices rise faster than DOE projected a year ago, then the measures pay back even sooner.
- The Budgets could have been set tighter and still be economically beneficial to the homeowner. However, to do so would require builders to use measures beyond their common experience. For the Standards to be maximally effective, they should encourage builders to try new energy conservation approaches. The performance approach with relatively stringent levels based on current technology has the potential of accomplishing this objective. Two innovative approaches that appear to have high potential for exceeding BEPS in a cost effective manner are reducing air infiltration levels of houses (and installing a small heat exchanger through a ventilation system to protect indoor air quality) and several passive solar designs.

- If BEPS does promote innovation and results in the commercialization of new energy conservation measures, then it will be possible to update BEPS and increase energy savings dramatically. This is one of the biggest potential benefits of BEPS.

There are still some unresolved issues regarding the Design Energy Budgets for single family residential buildings. The three most important of these, in my judgment, are (1) whether domestic hot water will be included in the Design Energy Budgets, encouraging solar water heating, but potentially at the expense of good energy conservation construction practice in the building envelope; (2) whether reductions in air infiltration rates, combined with techniques to assure good air quality, will be credited in BEPS; and (3) whether it is necessary to vary Design Energy Budgets with house size.

The Role of the Marketplace and the Need for Standards

Many individuals and groups have argued in the public testimony on BEPS that there is no need for standards because the market is responding fully to high and rising energy prices. About an equal number of individuals and groups have opposed BEPS because they believe it is too stringent and cannot be met by designers and builders. Clearly, if the market is already achieving BEPS, then BEPS cannot be too tight. Conversely, if the Budgets are too tight, then the market is not meeting or exceeding BEPS.

BEPS is known to be significantly tighter than houses conforming to the NAHB estimate of average building practice in 1975 and 1976. Specifically, BEPS is between 30 and 40 percent tighter than 1975-1976 construction practice for an average house in most parts of the nation.

If the energy use of a new house complying with BEPS is expressed in terms of houses built before the oil embargo, then the energy savings is between 60 and 70 percent.

An important issue raised in public testimony is: how does BEPS compare with the present building practice? An answer to this question would help resolve the issue of whether the market is in fact achieving BEPS without regulation. That analysis is underway, based on results from the National Association of Home Builders Researh Foundation (NAHB/RF) survey data.

In the absence of the full analysis, I am able to provide this Committee some rough estimates of market behavior, based on the information included in the NAHB testimony on BEPS. Our preliminary analysis indicates that the market has made improvements in energy conservation building practice for single family residential buildings since 1975-1976. In spite of this improvement, the average new house constructed in 1979 is not nearly as energy conserving as the BEPS house. We estimate that BEPS will reduce energy use by 30-35% compared to 1979 residential construction practice. This is a rough approximation; the more detailed investigation presently under way will provide more accurate information about different regions of the Nation, rather than relying on the statistical data for an average house in the U.S.

We have completed one other study that is highly relevant to the issue of the response of the market place. This study investigated the available data on the response of purchasers of residential energy using and energy conserving equipment to rising energy prices. (The report is by Fred Reid and may be obtained from LBL.) The important finding of this study is that a significant fraction of consumers are insensitive to energy prices and an even larger fraction are only weakly sensitive. The percentage of residential consumers judged insensitive to energy prices--renter, speculative builders and house purchasers, low income families, and others--was estimated to be between 28 and 38 percent of the market. The percentage of residential consumers judged weakly sensitive to energy prices was estimated to be between 24 and 49 percent of the market. It is these home buyers whom BEPS is attempting to reach. These individuals are not likely to respond very actively to market signals in the absence of government policies such as BEPS.

My preliminary conclusions from these studies are that:

- Some parts of the market are responding to higher prices. Many are not responding;
- Notwithstanding this response, BEPS will require significantly more conservation than is presently included in building designs;
- If BEPS is delayed for several years, then it may be appropriate to make the Design Energy Budgets more stringent so as to be consistent with the objective of speeding up the adoption of energy conservation; and
- An update of BEPS, based on the continually increasing ability of the building community to incorporate new energy conservation techniques into building design and construction, could greatly increase energy savings and should be considered seriously after BEPS has been adopted.

The Use of Weighting Factors

The National Institute of Building Sciences (NIBS) has stated that "Without exception, the most controversial aspect of the entire NOPR has been the inclusion of weighting factors which account for offsite energy consumption and the value to the Nation of conserving different types of fuel." NIBS further states: "Not only has the incorporation of weighting factors threatened the entire program, but it has also added a significant amount of complexity to an already complex situation."

There is a widespread perception that weighting factors discriminate against the use of electricity compared with other fuels for space heating. As a result, it is maintained, BEPS represents a fuels policy that favors the use of two fuel types--oil and gas--over that of electricity for space heating. These perceptions are in fact false for single family residential buildings, where different Design Energy Budgets are presented for gas, oil, and electricity. For commercial buildings, I believe the weighting factors do present a serious difficulty, because only one, average Design Energy Budget is provided regardless of the type of fuel used for space conditioning.

I first explain how weighting factors have come about, in an effort to clarify their impact. The use of weighting factors results from the ability of the building designer to choose a heating system using either electricity or fossil fuels. The question emerges: how can a Design Energy Budget be selected that will take this choice into consideration? For single family residential buildings, different budgets were set for each of the three major fuel types. These budgets were established by evaluating the cost effectiveness of energy conservation measures for each of the fuel types in different regions of the Nation. Once the budgets were established, the question then arose as to the units in which they were to be expressed. DOE made the decision to express them in terms of weighted energy units, where the weighting factors took into consideration the relative cost of the different fuel types and other factors affecting the value of fuel to the Nation. The decision was made to provide a weighting factor that *favored* the use of electricity over other fuel types compared to the effect of market prices. Thus, a weighting factor of 2.79 was used for electricity rather than a factor of 3.64 that would have been appropriate had the relative prices of the energy forms been used. Arguments have been advanced that favor the use of a weighting factor of 1 instead of 2.79 or 3.64. However, a weighting factor of 1 is not consistent with the relative cost of the fuel types, discriminates markedly in favor of electricity, and has little if any rationale to support it if one takes an economic approach to the setting of standards.

There is however a much more important point to make about weighting factors for residential buildings. *The magnitude of the weighting factor has very little influence on the Design Energy Consumption of a single family residential building.* The reason for this is that each different fuel type has its own weighting factor and this factor is used in conjunction with both the Design Energy Budgets and the Design Energy Consumption calculations. *It is not the use of a weighting factor that results in more energy conservation being required for electrically heated residences than for gas heated residences. The additional energy conservation results from the higher price of electricity for space heating.* The objections to tighter standards for electrically heated buildings have little to do with weighting factors; they have a great deal to do simply with the relative price of fuels, a fact that none of us has the ability to change.

I thus believe that the weighting factors make good analytical sense for residential buildings. I also believe that there has been considerable misunderstanding (if not distortion) of the effects of weighting factors. It is simply not true that it is three times more difficult to meet a Design Energy Budget for electricity because of the weighting factor. Because both the Design Energy Budget and the Design Energy Consumption of a building are multiplied by the same weighting factor, the effect cancels except in the case where a building exceeds its Design Energy Budget. However, I do not strenuously oppose seeking alternatives to weighting factors for two reasons: (1) their impact is in any case not so great (for single family residences) and (2) there may be simpler ways to express the BEPS requirements. Any alternative to weighting factors should continue to use an economic basis for the setting of Design Energy Budgets. The failure to apply economic concepts will result in undesirable distortions in the market place and will also cause inequities among different fuel types.

For commercial buildings, I believe there is a fundamental problem with the use of weighting factors as they are now proposed. This is because only one Design Energy Budget has been proposed for a given type of commercial building, regardless of the fuel mix used in the building. Under these circumstances, it may be impossible to use electricity for space heating in certain types of commercial buildings. I do not believe this was an intended result of DOE's Design Energy Budgets for commercial buildings. However, because only one Budget was proposed for each building type, the fuel choices were highly circumscribed for commercial buildings.

To summarize, I repeat one critical point that has been misunder-

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stood by most people who have commented on the weighting factors: for single family residential buildings, where different budgets are proposed for buildings using different types of fuel, the weighting factor is not responsible for the requirement that electrically heated houses are required to have more energy conservation than houses heated with gas or oil. The higher levels of energy conservation in electrically heated houses are a consequence of the high prices of electricity.

My other two key points are that (1) weighting factors are analitically sound, but other ways of expressing the Design Energy Budget may achieve their goals in a simpler way and (2) in the case of commercial buildings, the weighting factors cause serious problems because only one Design Energy Budget is presented regardless of the fuel mix of the building. The solution to this problem is to develop different budgets for commercial buildings with different fuel mixes.

BEPS Schedule

One of the most important decisions that this committee will recommend on BEPS is the schedule of its promulgation and implementation. There is a difficult judgement to be made between the desirability of avoiding unnecessary delay in reducing energy use in buildings and improving the BEPS program.

In my opinion the additional work needed to make BEPS more readily implemented will require about a year. I believe there are several areas in which this additional research and analysis would be highly beneficial:

1. Development and use in some states of one or several simplified techniques to determine compliance of a building design with BEPS.

2. Development of a method to avoid the problems caused by the use of weighting factors in commercial buildings, probably by establishing different budgets for buildings with different fuels.

3. The clarification of a number of technical issues, some of which I have discussed in this testimony.

However, I am concerned that a lengthy delay in issuing BEPS, such as a year or more, may easily be interpreted by the building community as a lack of resolve on the part of Congress in requiring energy conservation in buildings. As I understand the Congressional legislation, I believe Congress supports aggressive and effective energy conservation measures in buildings. The attitudes that caused Congress to set up the Building Energy Performance Standards Program, that insufficient energy conservation was taking place in buildings, are as true today as they were in 1976. If anything, the urgency of getting on with energy conservation is greater today than it was a few years ago.

The dilemma facing Congress is how to avoid creating the impression that Congress no longer supports an effective federal program to achieve cost effective energy conservation in buildings, while allowing DOE the time necessary to make BEPS better.

I think that this dilemma can be resolved by requesting that several states volunteer to participate in a BEPS demonstration program, and by providing sufficient funds for them to implement it, even while DOE is improving it. A condition to the grants should be that careful monitoring of the progress of the implementation be carried out; this would require that DOE has adequate resources to be able to provide technical assistance to these states and maintain very close liason.

The advantage of this program is that it will allow BEPS to be started in selected regions of the Nation, as many organizations have requested in the public testimony, as soon as the states could organize a plan for BEPS implementation. Some states, such as California and Minnesota, already have state building energy standards. These states, are thus in a favorable position to use their existing infrastructure to implement BEPS instead of their existing programs. The most important benefit of such a program is that it would provide the data needed to develop a national BEPS implementation strategy. This would avoid some of the pitfalls that innovative programs usually face.

In conclusion, I wish to stress that BEPS is a reasonable and desirable program, that DOE has accomplished many of the goals set for BEPS by Congress, and that many of the difficulties in BEPS are inherent in any performance standard. I believe that a delay of about one year can substantially improve the quality of the BEPS program, based on my familiarity with the research and analysis presently underway.

However, I feel that any delay should be accompanied by the committment of funds by Congress to initiate a BEPS demonstration program in several states. Such a program, if in the same legislation that approves a delay in BEPS, would demonstrate forcefully the Congressional resolve to promote cost-effective energy conservation in buildings, where the market has been slow to achieve this conservation on its own.

Senator **Johnston**. Gentlemen, if we may let's move on to the next panel because we have got the home builders and the wildlife federation on the next panel, and they will deal with these questions.

Thank you so much, Dr. Rosenfeld and Dr. Levine. If we hadn't had such interesting witnesses, we wouldn't have overspent the time. Thank you very much.

Next we have a panel with Mr. Norman L. Dean, counsel for the Energy Team of the Resources Defense Division of the National Wildlife Federation.

He is accompanied by Mr. David A. Strom, associate, Conservation Foundation.

We also have Mr. Fred Napolitano, vice president of the National Association of Home Builders. If you gentlemen, starting with Mr. Dean, if you would summarize briefly because we do have another panel, and then after the other panel, then another witness. We do want to allow time for questions, so if you would begin?

STATEMENT OF NORMAN L. DEAN, COUNSEL FOR THE ENERGY TEAM, RESOURCES DEFENSE DIVISION, NATIONAL WILDLIFE FEDERATION, ACCOMPANIED BY DAVID A STROM, ASSOCIATE, CONSERVATION FOUNDATION, INC.

Mr. **Dean**. Thank you. I am Norman Dean, counsel for the National Wildlife Federation which is the world's largest non-governmental conservation organization.

With me today is David Strom who is an associate for the Conservation Foundation, a not-for-profit research and educational institution.

You will have to excuse me. I have got a case of laryngitis and my voice may crack a bit throughout my testimony.

Mr. Strom is here with me today to answer any of your technical questions concerning the proposed rules.

In addition to our own organizations today, we are representing the Natural Resources Defense Council, the Center for Renewable Resources, the Federation of American Scientists, the Sierra Club, and the League of Women Voters of the United States.

I would like to emphasize five points to the committee. In our view, BEPS are superior to the alternative energy supply projects presently available to the country.

Second, we believe that these regulations are essential to encourage conservation in our Nation's buildings.

Third, we oppose any delay with respect to the promulgation of these standards.

Fourth, we consider the standards to be extremely lenient and urge that they be strengthened considerably.

Finally, we support legislation that would transfer complete authority for not only promulgation but for enforcement and implementation of the standards from HUD to the Department of Energy.

In reviewing the situation of BEPS, it is important to consider the context in which these standards are being proposed. It is significant that Congress is considering a 2-year delay in BEPS at the same time it is considering enactment of unprecedented legislation to accelerate the approval and development of synthetic fuels projects.

In our opinion, there is a serious inconsistency between calls that are being made to delay BEPS while we race ahead with large energy supply projects because measured by almost any standard—costs, environmental damage, or return on investment—conservation in buildings is superior to synthetic fuels production and to other energy supply programs under consideration by Congress.

For example, it is estimated that BEPS can supply energy at roughly $5 a barrel of oil equivalent while synthetic fuels are estimated to cost at least $38 per barrel of oil equivalent.

Unfortunately, energy conservation in our Nation's buildings simply will not occur without Government regulation. There is a recent Ford Foundation sponsored study that concluded, "The housing market is almost a classic case in which intelligently conceived regulation has a place."

The conclusions of the Ford Foundation study are borne out by a recent TVA survey of conservation measures in new homes. TVA's home insulation program found that of 6,211 homes surveyed that are less than 1 year old, 20 percent had no attic insulation at all; 37 percent had less than R-19 attic insulation; and 83 percent had less than R-30 attic insulation; 85 percent had no floor insulation; and 35 percent had single glazed windows.

In fact, data put out by the National Association of Home Builders shows that there has been a decrease in the amount of insulation used in new homes.

Despite the many advantages offered by BEPS, Congress now has before it a 2-year delay in both the promulgation date and the effective date of those standards. In our opinion, such delays are not justified. The direct loss from delay will be staggering. We estimate that the 2-year delay would waste roughly $2 billion in extra fuel costs alone. The American Institute of Architects, which as you probably know also opposes any delay, estimates that the proposed 3-year delay will cost $4.3 billion.

In our view, there are a number of practical reasons why a statutory delay will be ill advised. A vote by Congress for a 2-year delay will be an unfortunate signal to the Nation that we are no longer serious about energy conservation in buildings. It would further perpetuate the myth that there really is no energy crisis in this country.

Second, a statutory delay would be a signal to budget cutters that they are free to cut back DOE's already threatened conservation budget.

Finally, there are those overly optimistic individuals who argue that DOE will be able to issue its standards in less than 2 years even if a 2-year statutory delay is passed.

I would ask those individuals when was the last time they heard of an administrative agency issuing final regulations before a statutory deadline?

In our view, neither DOE nor the industry has offered sound reasons for the delay of these standards. We are not surprised to find that the housing industry is encouraging delay of BEPS. Few industries are willing to accept regulation of their activities, and the housing industry is no exception. However, we find their position with respect to BEPS to be strangely contradictory.

On the one hand certain portions of the industry are claiming that the standards are too stringent and cannot be achieved at reasonable cost. On the other hand, there are simultaneous claims being made that regulation is not necessary because builders are already building energy efficient structures.

Senator **Johnston**. Excuse me for interrupting. I hate to be discourteous to our witnesses, but I wish you would quickly summarize so we can find out what it is that the Home Builders object to, and then get a little dialog between you two as questions. As it is, we are not going to finish even this panel before the lunch hour, and we have another panel after this and another witness after that.

We are awfully pressed for time, so if you would summarize quickly.

Mr. **Dean**. I would be happy to. I have I think only two other major points to make. I can make them fairly briefly.

First, we don't think that these standards, as was confirmed by Dr. Rosenfeld's testimony this morning, are as strict as many have claimed. In fact, they are very lenient standards. One particular area of weakness——

Senator **Johnston**. Excuse me. I am advised that the panel members have all read the statement, so we are ahead of you. Could we go on to the Home Builders and then we will come back with some questions.

[The prepared statement of Mr. Dean and an attachment from the Conservation Foundation follows:]

TESTIMONY ON THE
PROPOSED ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS

presented to the

SUBCOMMITTEE ON ENERGY REGULATION
of the
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

by

National Wildlife Federation

The Conservation Foundation

Natural Resources Defense Council

Center for Renewable Resources

Federation of American Scientists

Sierra Club

League of Women Voters of the United States

June 5, 1980

Good morning. I am Norman Dean, counsel for the National Wildlife Federation, a national conservation group with more than 4.6 million members and supporters. My address is 1412 16th Street, NW, Washington DC. With me is David Strom, associate for the Conservation Foundation, a not-for-profit research and educational institution. His address is 1717 Massachusetts Avenue, NW, Washington DC. Mr. Strom will respond to questions about the technical content of the rules. In addition to our own organizations, we are here on behalf of several other groups concerned with energy conservation issues: the Natural Resources Defense Council, a non-profit national environmental group with more than 45,000 members; the Center for Renewable Resources, a not-for-profit research and educational institution devoted to the study and promotion of the use of solar and other renewable sources; the Federation of American Scientists, a 35-year old public interest group representing over 5,000 scientists; the Sierra Club, a national environmental lobbying group with almost 185,000 members; and the League of Women Voters of the United States, a volunteer citizen education and political action organization with 125,000 members in all 50 states, Puerto Rico, the Virgin Islands, and the District of Columbia.

One of the organizations I represent today -- the Conservation Foundation -- has spent considerable time and resources attempting to educate the public on the costs and benefits of BEPS. The Foundation's BEPSGram series of newsletters offer a lucid and insightful discussion of the issues underlying BEPS. I thought the Committee might find these newsletters helpful so I have brought copies of them with me today.

In our testimony today, we would like to emphasize five major points (1) BEPS are superior to alternative energy supply projects, (2) regulations are essential to encourage conservation in buildings, (3) there should be no further delays in promulgating the Standards, (4) the proposed Standards are extremely lenient, and (5) DOE, not HUD, should have primary authority for the Standards.

BEPS ARE SUPERIOR TO ALTERNATIVE ENERGY SUPPLY PROJECTS

In reviewing the significance of BEPS, it is important for this Committee to evaluate BEPS in the context of the alternative energy programs available to the nation. It is significant that Congress is considering a two year delay in BEPS at the same time it is considering enactment of unprecedented legislation to accelerate the approval and development of synthetic fuels projects. I speak, of course, of the Energy Mobilization Board and the Energy Security Corporation legislation now before Congress. In our opinion, there is a serious inconsistency between calls that we go slow on BEPS while we race ahead with these large supply projects. Measured by almost any standard -- cost, environmental damage, or return on investment -- conservation in buildings is superior to synthetic fuels production and other energy programs under consideration by Congress. For example, BEPS can "supply" energy at roughly a cost of $5 a barrel equivalent, while synthetic fuels are estimated to cost at least $38 per barrel of oil equivalent.

Moreover, the opportunity for saving energy through BEPS is enormous. Buildings consume about a third of all energy we use. A calculation by the Consumer's Energy Council of America indicates that each new building operating under present energy codes (without BEPS) will use two barrels of oil per year equivalent more than if the building were designed to meet BEPS specifications. Multiplied by the millions of new buildings each year, this represents a substantial amount of energy.

REGULATIONS ARE ESSENTIAL TO ENCOURAGE CONSERVATION

Unfortunately, there will not and cannot be sufficient energy conservation in buildings without government regulation. A number of recent studies -- including ones by Resources for the Future (RFF) and the National Academy of Sciences -- have found that sufficient conservation will not occur without government regulation. The recent Ford Foundation - RFF sponsored study concluded that " ... the housing market is almost a classic case in which intelligently conceived regulation has a place." The National Academy of Sciences CONAES study found that

> any decision to improve efficiency must be encouraged by building code standards, financial incentives, and information campaigns. Builders have inadequate incentives to minimize life cycle costs; in fact, they tend to favor low initial costs instead.

The conclusions of these studies are borne out by a recent TVA survey of conservation measures in new homes in Tennesee cited by Dr. Maxine Savitz. The study states that one-fifth of homes that were surveyed by TVA had no ceiling insulation at all, and four-fifths had neither floor insulation nor any double-glazing.

There are four major reasons why even the sharply higher energy prices we are experiencing will not encourage sufficient energy conservation in buildings:

First, even with higher energy prices, builders and consumers are not paying the true cost of energy. Government regulation has artifically held down the price of electricity, oil and natural gas. One DOE estimate found that the "marginal" cost of electricity, natural gas and oil to residential customers presently exceeds the market price by as much as 99 percent, 55 percent, and 89 percent, respectively. Although the federal government is now moving to deregulate oil and natural gas, both electricity and natural gas (which comprise over 75% of residential energy use) will continue to be regulated by state utility commissions for the foreseeable future. The almost universal practice by these commissions of averaging relatively cheap older supplies with relatively high cost new supplies will continue to result in energy prices to residential customers that are far below marginal cost. DOE's own projections hsow a wide variation between the "marginal" and average costs of gas and electricity out to the year 1995. In addition, the cost of energy to residential customers is artificially low because it does not include the many "external" or social costs of energy use such as air pollution generated by coal combustion and increased reliance on foreign sources of energy supply. Regulations are needed to provide the right signals to consumers in absence of correct prices for energy.

Second, the individuals who pay for the heating and cooling of buildings usually have no role in the design or construction of those buildings. Over two-thirds of the single family homes built by developers in 1977 were sold on the open market. Builders have great incentive to keep first costs as low as possible and ignore the operating costs. Tenants who rent are further separated from the process of designing energy-efficient construction.

Third, buying a new house is in some ways like buying a pig in a poke. Many consumers do not have sufficiently accurate information on the energy characteristics of new homes. Without any existing performance standards, a consumer has no systematic way of comparing the "miles per gallon" ratings of new homes. BEPS, with the design budget levels, can provide this information directly, as well as stimulate even further education in the industry on energy-efficient structures.

Fourth, consumers have a tendancy to minimize first costs. Studies have shown that most home owners are reluctant to increase first costs of homes so as to save on future operating costs. There are two reasons for this reluctance -- an uncertainty over future prices of energy and the frequent moves of consumers diluting the benefits from the increased inital cost. Regulations like BEPS are needed to encourage consumers to minimize first costs.

The New York Times summarized these points by saying in a recent editorial:

> [T]he free market needs help to do the job right. Home buyers are not sophisticated consumers of energy technology. And builders, who are quick to spend on cosmetics like dishwashers and marble counters, are demonstrably slow to install unglamorous energy savers.

THERE SHOULD BE NO FURTHER DELAYS IN PROMULGATING BEPS

Despite the many advantages offered by BEPS, Congress is considering a significant delay in both the promulgation date and the effective date of the Standards. Both House and Senate Banking committees have reported bills (HR 7262 and S 2719) that would delay the promulgation and effective date of BEPS by two years. In our opinion, such delays are not justified.

The direct losses of delay would be staggering. We estimate that a two year delay would waste roughly $2 billion in extra fuel costs alone.

We oppose any further delays in the promulgation of BEPS. DOE should be given the resources necessary to promptly issue and implement the proposed Standards. Presently, the Department has only three individuals who are working on the program. Although seven additional positions are available, these additional positions have not been filled. This committee should act to assure that DOE receives and allocates adequate resources to complete this important job.

There are four reasons often given to delay the promulgation of BEPS:

First, it is said that the concept of performance standards is new and consequently, builders, code officials, and other affected interests must be given time and help to understand and respond to the new standards. But delay in promulgation of the Standards can hardly contribute to improved understanding. The process of educating and training affected parties can only start when the Standards are issued. The later this is, the longer this training process will take. Delay alone provides no assurance of future industry responsiveness or better regulations. Rather, it is an invitation to seek continued postponements.

Morever, even if some interests will have problems responding to the Standards this is no reason to delay the entire program. At least some states and builders are presently ready and willing to implement BEPS. Their actions and leadership will be of greater benefit to those in need of help than any additional regulatory revisions.

Second, it is said that the promulgation of BEPS should be delayed because there are presently no equivalent "cookbooks" to translate the Standards into more familiar component-based approaches. DOE has promised that the cookbooks will be included in the final regulations. To our knowledge, there are no great technical obstacles to this task; in fact, at least two states have already translated performance standards into "cookbook" standards in a relatively short period of time. Rather than further delaying promulgation, Congress should give DOE the resources necessary to promulgate the Standards with the cookbook equivalents.

Third, it is argued that BEPS should be delayed because they may increase the first costs of homes at a time when the housing market is already depressed. Even if the increase were $1500 on a home costing $60,000 -- twice the increase predicted by DOE -- the impact to the homebuyer would be less than that caused by a change in mortgage rates from 12 to 14%. It therefore makes little sense to single out BEPS as a likely significant factor in the market for housing.

Fourth, critics contend that BEPS should be delayed because the proposed rules have many technical deficiencies. While no regulation is ever perfect, most critics have argued that further research must preceed issuance of the Standards. Although we agree that many improvements in BEPS are desirable, none of the alleged deficiencies is sufficient to justify delay. Rather than delay the entire program we believe DOE should be required to issue a "research and development agenda" at the same time the Standards are promulgated. The agenda will serve as a way for DOE to address the problems of BEPS sensibly and thoughtfully by scheduling needed research, rather than constantly devoting resources to temporary and patchwork solutions. The agenda will also show how often the

Standards need to be updated so as to incorporate the results of this research. Congress clearly required this "updating" in the enabling legislation for BEPS and there is support for such an agenda by groups like the American Institute of Architects.

Indeed, use of a performance standard makes these successive improvements easier, since the budget levels can be changed as new research results become available. Congress can use the agenda as an effective way to schedule scarce scientific and fiscal resources to produce the best BEPS possible.

We are not surprised to find the housing industry opposing BEPS. Few industries willingly accept regulation of their activities, and the housing industry is no exception. The industry's position with respect to BEPS is highly contradictory -- the industry claims on the one hand that the Standards are too stringent and cannot be acheived at reasonable cost, while on the other hand simultaneously claiming that regulation is not necessary because builders are already building energy-efficient structures.

This Committee's previous experience with automobile efficiency standards, which also incorporate a performance approach, is instructive. The auto industry bitterly opposed regulation, arguing as does the building community, that the standards could not be met and would endanger the health of the industry. The industry not only met the standards but greatly benefited from them. Smaller, more fuel-efficient cars have become the industry's best-seller, and without them the plight of domestic auto manufactures would surely be far worse than it is today. We believe the same will hold true with respect to BEPS. The housing industry will ultimately benefit from these Standards.

BEPS ARE EXTREMELY LENIENT

We are surprised at the number of proposals to delay the promulgation of BEPS, especially in light of the leniency of the Standards. The Energy Conservation and Production Act required DOE to set standards that were designed to achieve the "maximum practicable level of improvements in energy efficiency and increases in the use of nondepletable sources of energy." Yet the Department of Energy has proposed Standards that do not take into account many existing measures that are cost-effective applications of conservation and renewable resources. Such items as heat exchangers, automatic set-back thermostats, and reduced north-facing glazing are being used with increasing frequency in this country but have not been taken into account in setting the Standards. BEPS, as we have said before, should anticipate such items and encourage their use.

One particularly noticeable weakness with the proposed BEPS is their failure to recognize the important potential contribution of solar energy for both water heating and climate control. This potential was not included in the current research effort despite the demonstrated benefits of passive solar designs in nine out of ten representative cities studied by DOE. DOE's exclusion of passive solar is also inconsistent with the decision to make passive solar energy an important program component for the federal Residential Conservation Service Program.

The Standards are also lenient because they are based on low estimates of energy prices and on assumed operating conditions for buildings that are consistently biased against conservation. In addition, the Standards rely on a study of buildings designed in 1974-75, a period in which builders and architects had not yet had time to respond to higher prices and new energy-efficient methods.

We urge this committee to reiterate to DOE the intention of Congress that BEPS were meant to achieve "maximum practicable energy savings."

DOE SHOULD HAVE AUTHORITY FOR IMPLEMENTING THE STANDARDS

Recently, there has been considerable debate over whether DOE or the Department of Housing and Urban Development should implement BEPS once they are promulgated. As the Senators know, originally the entire BEPS program was housed in HUD, where the early work on developing the Standards was done. However, the DOE Organization Act of 1977 transferred authority to develop the Standards themselves to DOE, leaving the implementation, regulations, and monitoring at HUD. HUD and DOE haved signed a Memorandum of Understanding which permits DOE to continue to develop the implementation program, leaving the enforcement authority at HUD. Unfortunately, the Memorandum expires this August and HUD is reportedly unwilling to renew it.

This is no time to change horses in midstream. A transfer in implementation authority back to HUD would doubtless involve a significant delay in implementation. There is no way in which HUD can master the intricacies of the Standards and propose a sound implementation program soon after BEPS are issued.

We feel that authority should be permanently transferred to DOE. DOE should be responsible for developing the Standards and the implementation program, as well as enforcing the regulations. The Senate bill, S 2719, would accomplish this transfer.

We strongly support this transfer for three reasons:

- First, the relationship among the Standards, their implementation, and their enforcement is unusually close. BEPS are not self-enforcing. The shape of the Standards is influenced by how implementation and enforcement are accomplished. Indeed, the reverse relationship is also critical: the implementation program can affect how the Standards should be set. For example, one of the important questions facing the development of the Standards is how to simplify the calculations so that local, understaffed building code officials can handle them easily. Answering this question will determine whether resources should be provided directly at the local level or if technical centers should be established to provide assistance on demand for the local agencies. If HUD and DOE together were to try to answer such questions -- even with the most careful interdepartmental cooperation -- misunderstandings, wasted time, and needless conflicts would result. This close relationship between the standards and their implementation is the most persuasive reason for giving DOE the sole implementation authority.

- Second, the research and analysis underlying the proposed standards is voluminous and technical. This is not to say that HUD would be unable to gear up for such a task, but there would be a period of learning that could be avoided if those who developed the Standards also worked on their implementation.

- Third, BEPS is an energy program, not a housing program. It should be integrated with other energy programs for budget and planning purposes. We have asked the Department of Energy to be responsible for energy. Because BEPS is such a vital part of that program, it belongs in that Department.

CONCLUSION

In closing, we believe BEPS offer an important and necessary opportunity for the Nation to reduce its reliance on conventional and costly sources of energy supply. BEPS can "produce" energy more easily, quickly, cheaply, reliably, and with less damage to our environment than synthetic fuels and other proposed supply projects. The fact that a prior Congress had the foresight to enact this program should give all of us hope we can become a more energy efficient society, living well with less waste. We have already waited four long years for these important Standards. Congress should take steps to assure that BEPS are promulgated and implemented as soon as possible. The American consumer has a right to expect that the next new house he or she purchases will be the most efficient one that American ingenuity and good sense can devise.

Thank you for the opportunity to present our views.

Beps Gram

The Conservation Foundation
1717 Massachusetts Avenue, N.W., Washington, D.C. 20036

Dear Friend:

Your name has been given to us by
who thought you would be interested in receiving material on the Building Energy Performance Standards.

Enclosed you will find background information on B.E.P.S. and the past mailings we have prepared. We will be sending you series of mailings to assist you in analyzing these regulations.

If we can be of assistance to you, please write or call collect (202/797-4370).

Yours very truly,

Grant P. Thompson

Grant P. Thompson
Senior Associate

Enclosures

THE BACKGROUND TO BEPS

This paper has two parts. First, there is a short description of the pre-BEPS standards and codes that regulated energy consumption. Second, the BEPS are described and criticized.

Energy Standards for New Construction: Pre-BEPS

Regulation of energy use within buildings does not have a long history in this country. To be sure, a few examples of requirements for relatively minimal amounts of insulation can be found, but before 1970 there was little general interest in energy-efficient construction. The most wide-spread program was not mandatory, but was a set of voluntary guidelines adopted by electric utility companies interested in making the cost of operating electric heating competitive. Homes that complied with the guidelines were awarded a Gold Medallion. The first systematic, nationwide interest in energy conservation for buildings came as a reaction to the oil embargo of 1973-74. At that time, a voluntary group representing the heating, cooling, and ventilating professions began the process of drawing up an energy efficiency code for new buildings. The group, the American Society of Heating, Refrigeration, and Air-conditioning Engineers, Inc. (ASHRAE), intended to add to their growing list of standards covering subjects ranging from ventilation rates to humidity control. Because the standard was to be the nintieth in the list of ones they had developed, it was called Standard 90P, the "P" standing for proposed.

ASHRAE and other similar voluntary professional societies were experienced in developing standards and had developed a process for making certain that all economically affected parties had an opportunity to comment on and offer revisions to a standard before it was issued in final form. This so-called consensus process demands Herculean devotion from its participants who voluntarily attend meeting after meeting without pay or travel expenses, arguing over comments ranging from word changes to the most fundamental revisions. The consensus process, by its very nature, guarantees that any standard surviving the process will have two characteristics: it will not be unacceptably controversial and it will have had little input from any person who did not have some strong (usually economic) reason to donate a very large amount of time and effort to the process. ASHRAE standards are extremely influential. Their influence comes from the fact that they are technically sound, generally accepted by most directly affected interest groups, and usually cover highly technical subjects that no non-federal level of government would have the resources to regulate thoroughly and accurately. For this reason, many local or state laws and ordinances simply refer to a particular standard, thus giving it the force of law.

ASHRAE issued its standard in final form in 1975, and it was given a suffix indicating its vintage: Standard 90-75. In the meantime, Congress had reacted for the first time to the energy crisis by passing the Energy Policy and Conservation Act (P.L. 94-163, effective December 22, 1975). Section 362 of that Act required each state to develop energy conservation plans that included five mandatory provisions. One of those provisions was "mandatory thermal efficiency standards and insulation requirements for new and renovated buildings." The federal government seized upon ASHRAE Standard 90-75, declaring that any state that adopted the Standard or its equivalent would be deemed to have complied with the Energy Policy and Conservation Act, and thus be eligible for federal assistance. In order to assist states in using ASHRAE Standard 90-75 even more rapidly, the federal government funded another voluntary group, the National Conference of States on Building Codes and Standards, to change the Standard (a format that is unsuitable for enactment) into a code format, which local building code departments could apply. NCSBCS also developed, under contract to the federal government, a set of training courses for building code officials to familiarize them with the code based on ASHRAE Standard 90-75.

The ASHRAE standard is what is called a "component-performance" standard. This means that the builder is instructed to look at each element of a building (that is, the walls, the floor, the ceiling, the heating plant, and so on) and make certain that each one of those components had a certain minimum thermal integrity or performance. Any builder assembling a building made up of various elements, each of which had passed the Standard, would be guaranteed that the final building would be in compliance with the Standard.

This component-performance standard is relatively easy to administer, but various groups, spearheaded by the American Institute of Architects, argued that such a standard stifled innovation in building design and, in many cases, mandated construction practices that were actually wasteful of energy. After considerable efforts at persuasion, proponents of this viewpoint prevailed on Congress to mandate that states follow a quite different approach, one that looked at the total energy performance of a building. In the Energy Conservation and Production Act (P.L. 94-385, effective August 14, 1976) Congress required the Department of Energy to develop performance standards for new buildings. Section 303(9) of ECPA defined a performance standard as "an energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed in achieving that goal or goals, but including statements of the requirements, criteria and evaluation methods to be used, and any necessary commentary." The critics of the component performance standards had won a victory in the legislative arena. They had also set the Department of Energy on a long, technical, controversial, and demanding course, whose end is not yet in sight.

Development of BEPS and Critique of Their Current Form

The original legislation mandating development of BEPS gave the government three years -- that is, until August 14, 1979 -- to develop the standards in their final form. The fact that BEPS were just issued in proposed form on November 28, 1979 gives some clue of the actual schedule that has been followed. It goes without saying that criticisms of BEPS at this point can only be based on the Proposed Notice of Rulemaking (to be found in 44 Federal Register 68120). Changes are both desirable and likely in the final form of the rule. The present schedule calls for promulgation of the regulations in May, 1980. However, the Department is seeking to find more time to revise and rework parts of the rule. It may well be toward the end of 1980 before final rules are available.

Under the original legislation, both the technical standard for BEPS and the implementation plan were to have been developed by the Department of Housing and Urban Development. Congress transferred the authority to develop the technical basis for the standard to the Department of Energy; however, it left the implementation development with HUD. It soon became clear that this arrangement was unworkable, since the standard development and the implementation plans are so closely allied to one another. Therefore, the two Departments entered into a Memorandum of Understanding, delegating implementation to DOE. In a confusing recent development, HUD suddenly refused to renew the Memorandum, then just as suddenly agreed to renew it. The early development of both the BEPS standard and the implementation plan were carried out at HUD. This transfer and retransfer of authority has added enormously to the difficulty of developing a workable standard.

In the early stages of standard development, HUD chose the American Institute of Architects Research Corporation as the lead contractor for the standards. In broad outline, HUD and AIA/RC decided to look at what American builders were actually designing shortly after the oil embargo, then use the best of those actual designs as the new standard for all builders. This method of setting a standard demonstrated that HUD and AIA/RC had two strong views of energy conservation in buildings. First, it showed they believed it should be based on present technology in actual use. This view is contrary, in our opinion, to the intent of the legislation, which sought to use BEPS as a technology-forcing device, bringing new designs and new technics into common use. Second, it showed that HUD and AIA/RC did not share the economists' view of energy conservation (that it is simply cost-minimization), but rather took the engineers' view (that it is plugging leaks as their existence becomes known to you).

Let us now turn to a somewhat more detailed description of the process AIA/RC followed in developing the standards. Although some of this story is now simply history, the data collected in the effort continues to exert a strong influence on the Department of Energy's views concerning what builders can actually do. AIA/RC began by surveying a large number of buildings designed during 1974-75. This period was picked both because designs were available, and because it was assumed that designers and engineers had by then taken new, higher prices into account. Enough buildings were selected so that a statistically significant sample was available for various building use categories and climate zones (defined on the basis of heating degree days only). AIA/RC used a sample size of 1,661 non-residential buildings. Data drawn from the plans of each of these 1,661 buildings were entered into a computer that estimated the amount of energy the building would consume, using a proprietary program (AXCESS) developed by the Edison Electric Institute. The computer output consisted of a figure showing how many British Thermal Units (BTUs) of energy each building would use per square foot per year.

The data generated by AXCESS permitted AIA/RC to prepare an matrix of American non-residential buildings, organized by climate zone, by building type, and by predicted energy consumption. (For example, by looking at the data books, it was possible to show a range of energy use per square foot for hotels located in climate zone 7.) This large data collection effort formed the basis for standard setting.

In order to test how much further an average designer could improve on a design, the AIA/RC then selected a sample of about 10 percent of those buildings and asked the architect teams who designed 161 buildings to attend a three-day training session on energy conservation in building design. Following this intensive session, each design team was asked to redesign their original building, but to do it within the original budget guidelines established by the client, with no additional use of active solar energy, and complying with any particular requests of the client no matter what their energy consequences might be. The result of this Phase II redesign effort should give all of us renewed hope for the future of American education! Fully 80 percent of the redesigns were so good that if they had been categorized with the original 1,661 buildings, they would have fallen at or above the top fifth of that group as measured by energy efficiency.

In the case of residential buildings, the Department took a different approach, although it was likewise one based on technical improvements in the building stock. Using data collected for a different purpose by the National Association of Home Builders, the Department analyzed the energy consumption of these residences using a computerized version of the ASHRAE Modified Degree Day Method. Experienced designers were asked to develop prototype residences that were based on the median characteristics of the houses surveyed. These prototypes were then re-analyzed for energy consumption. Again, a technically-based methodology was used in order to set the energy performance standards.

Based on the analysis of the AIA/RC and the NAHB data, the Department selected energy budget figures that would have forced designers of all non-residential buildings subject to the BEPS to be as conscious of energy as were the better third to fifth of their colleagues. In the case of homes, builders would have been required to comply with the Thermal Performance Guidelines issued by the National Association of Home Builders. This form of the BEPS was released in an Advance Notice of Proposed Rulemaking at the end of 1978.

The criticism of these preliminary BEPS was immediate and harsh. Although there were many detailed criticisms of particular provisions, three important drawbacks were noted:

First, the standards were based simply on existing technology and based on buildings in which energy was not particularly singled out for special attention. Even in the case of the Phase II redesigns, the design teams were constrained by considerations that showed little sensitivity to use of new techniques, new machinery, and new ways of persuading clients and designers to save energy.

Second, the standards were based on buildings that were designed almost immediately after the original oil embargo. The market had not had time to readjust to the higher prices, and many clients and architects believed that the crisis would soon be over with a return to lower prices. The standards that the Department was proposing to issue stated, in effect, that in the 1980s, American designers were required to design buildings only as well as many of their colleagues were already doing in 1974.

Third, and most fundamentally, the technically-based standards ignored the most basic question of energy consumption and conservation: what is the economic balance between the discounted present cost of using energy in the future and the capital cost of taking steps to avoid using that future energy. As the recent Ford Foundation sponsored energy study, Energy: The Next Twenty Years, states the case:

> We mean by conservation those energy-saving investments, operating decisions, and changes in the goods and services that we buy and use that save money over the life of energy-consuming products. Money can be saved by substituting intelligence, prudence, maintenance, better equipment, or different equipment for purchased energy; the substitution should be made up to the point where the cost of not using the energy is equal to the cost of the energy saved.

By ignoring the life cycle costs of buildings, the Department's strategy established standards that had no sound analytic basis. The House Report on H.R. 8650, an earlier version of the bill that was eventually passed establishing BEPS, made it clear that this economic basis was what Congress had in mind. The Report noted that the bill was designed to:

> introduce discipline in the construction process which will result in lower costs to the consumer and in higher quality buildings. The Committee recognizes that the construction of more energy efficient buildings will result in higher development or initial

> costs under CURRENT DESIGN PRACTICES. However, the Committee received abundant evidence that the potential reductions in annual utility bills can offset the annual amortization costs of fairly substantial increases in front end construction costs. ... The Committee does not regard the higher capital costs involved in energy efficient buildings to have any serious consequences with respect to the marketability of homes. ..."
> H.R. Report No. 94-377, 94th Congress, 1st Session, 3 (1975).

A technically-based standard is virtually impossible to revise intelligently as fuel prices rise, since the cost/benefit calculations that form the basis of such analysis are completely missing.

For whatever combination of reasons, the Department abandoned its original goal of promulgating final regulations in February, 1979. Instead, a major new research program was undertaken in order to put the BEPS on a sounder intellectual footing. The fruits of this further labor are now available within the last few days. Let us now turn to an analysis of the new format of the BEPS.

Standard for Residential Buildings:

For the revision of BEPS, the Department undertook a number of economic studies in order to determine the life cycle costs of residential buildings. The preamble to the Notice of Proposed Rulemaking states that such a life-cycle analysis "permitted the use of well-defined economic criteria that have the potential of maximizing the net economic benefits to homeowners and to the Nation, as well as achieving maximum practicable energy conservation." In carrying out the life-cycle analysis, however, the Department constrained itself in a number of ways. It considered the use of energy conservation measures and techniques only if they are currently in common practice in the United States. Included were such conventional and timid measures as increased levels of insulation in the walls, ceilings, and floors, and use of double and triple glazing. Similarly, no conservation measure that required any significant changes in behavior or level of amenity of the occupants was permitted. For calculation of costs and benefits, the Department used the Energy Information Administration's Series B Midterm Price Forecast (44 Federal Register 25369, April 30, 1979). The discount rate was set at 3 percent, corresponding to an interest rate 3 percent higher than the inflation rate. No doubt there will be wide and merited discussion concerning whether these parameters are correct, in view of the trend of price rises and the discount rates actually used by individuals in their own economic calculations.

What effects are the BEPS likely to have on real houses? Of course, in one sense, it is impossible to answer this question. By legislative design and purpose, the federal government is not to use these standards to dictate any particular architectural solution to meeting the standard. But in actual practice, the Department from the first recognized that small builders and designers would need assistance in understanding what kinds of buildings would be likely to pass an inspection based on BEPS. Therefore, the government intends to provide a number of "cookbook" solutions for use by designers. The HUD Minimum Property Standards will be revised so that builders complying with them will also automatically comply with BEPS. Instructions will be given concerning modifications that are necessary in ASHRAE Standard 90-75 in order to make buildings designed to meet it also meet BEPS.

Most helpfully for persons trying to understand the effect of BEPS in the real world, the Notice of Proposed Rulemaking contains a sample list of measures that could be taken in order in the design of a single-family residence in order to comply with the Standards. Let us look at two examples:

- For a gas heated home located in Chicago, Illinois, a designer could follow any of these three paths: (1) windows 15 percent of floor area distributed equally on the four walls, triple glazing, R-38 ceiling and R-19 wall insulation; or (2) windows redistributed so that south facing window area is increased by 75 percent, and east, west, and north facing window area is decreased by 25 percent, double glazing, and R-38 ceiling and R-19 wall insulation; or (3) an active solar domestic hot water heating system supplying 60 percent of the hot water needs of the home, double glazing, an R-38 ceiling and R-11 wall insulation.

- For an electrically heated home in Atlanta, Georgia, a designer could meet the standards in a number of ways, including by following any of these three packages: (1) windows 15 percent of the floor area distributed equally on the four walls, triple glazing, R-38 ceiling, R-19 wall, and R-11 floor insulation, heating supplied by a heat pump; or (2) windows redistributed so that south facing window area is increased by 80 percent, and east, west, and north facing window area is decreased by 27 percent, double glazing, R-38 ceiling, R-19 wall, and R-11 floor insulation, heating supplied by a heat pump; or (3) an active solar domestic hot water heating system supplying 60 percent of the hot water needs of the home, double glazing, R-30 ceiling, R-19 wall, and R-11 floor insulation, heating supplied by electric resistance.

The careful reader will have noticed that although the heating loads vary enormously between Chicago and Atlanta (on base 65 F^{o}, Chicago accumulates 6639 degree days, while Atlanta accumulates only 2961), the strategies that must be used to meet the BEPS are essentially identical. How can this be when the heating needs are so different? The explanation lies in the fuels the designer chose for heating: the Chicago home uses natural gas, while the Atlanta home uses electricity. The Department is thus taking into account more than just the energy use that registers on the customer's meter; it is subjecting this consumed energy to different weighting factors for each fuel type. What are these weighting factors? In effect, they are numbers assigned to each fuel type; the designer is required to multiply the amount of electricity, natural gas, or oil by the appropriate weighting factor before he adds up the number of BTUs per square foot per year the building uses.

How are these weighting factors derived? The weighting factor in the current version of the BEPS starts with the average price of fuel consumed. (Average prices of energy are based on the existing mix of old and new energy sources; replacement costs are the costs of new energy sources such as a new powerplant.) Naturally, if the BEPS propose to use economic criteria for evaluating life cycle costs, only the replacement or marginal cost of energy consumed is the proper measure of the value of energy consumed. Since the homeowner must make the choice between avoiding energy consumption (i.e., buying conservation) at marginal costs, only by considering the marginal costs of energy not consumed can the equation work fairly. As the Ford Foundation study notes, average prices

> are typically below the cost to the nation of replacing the energy consumed -- that is, they are below the marginal cost of the energy. Analysis of the regulations based solely on prices paid by the consumer will therefore understate the value to the nation of more energy-efficient buildings.

> This failure to use the regulatory process for correcting deficiencies in the residential energy market is unfortunate because the housing market is almost a classic case in which intelligently conceived regulation has a place. Homebuyers do not generally think in terms of life cycle costing. ... A standard that ... took into account the benefits of energy conservation to both the consumer and to the nation, and that permited exceptions in cases where direct regulation was inappropriate would have a great deal to commend it.

The weighting factors used by DOE also include a premium for oil and natural gas, in order to press building designers away from using these fuels. Finally, the weighting factors were based on national averages, not on regional differences in fuel costs or availability. The weighting factors chosen by DOE are as follows:

Building Type	Natural Gas	Oil	Electricity
Single-Family Residential	1.0	1.22	2.79
Commercial and Multi-family Residential	1.0	1.20	3.08

The effect of these weighting factors is to make it more "expensive" in any given energy budget to use electricity, somewhat less "expensive" to use oil, and least "expensive" to use natural gas. Solar energy and other renewable energy resources are "free" according to this scheme, so the use of such sources is highly encouraged. The other effect of the weighting factors, of course, is to announce in effect a fuels policy for the American building industry.

How Strict are the BEPS?

Any detailed analysis of the BEPS for residences is certainly premature at this time. The Department based many of its decisions on Technical Support Documents (TSDs) that were not publicly released at the time the proposed rule was published in the Federal Register. These TSDs cover such crucial analytic topics as "Energy Budget Levels Selection," "Weighting Factors," "Economic Analysis," and "Passive and Active Solar Heating Analyis." Neither is it necessary to offer a detailed criticism of rules that may well be improved by the comment process. Nonetheless, one can legitimately look to the cast of mind of the Department as it selected these budget figures. In the selection of the energy budget figures for homes, the department considered four levels: the level they chose, 10 percent tighter, 20 percent tighter, and 25 to 30 percent looser. Energy savings were 11 quads (summed over the 40 years from 1980 to 2020) for the alternative selected, but 16.5 quads for the tightest standard. Both the standard selected and the tightest standard were found to have approximately equal and favorable economic impacts on the nation and on the homeowner. The first costs of the alternative selected would be between $750 and $1,500 added to the base cost; for the tightest alternative, the additional first cost ranges from $1,500 to $3,000 (although the Department's analysis shows this first cost will tend to be smaller as new energy conservation technology is introduced to meet the tighter standard). Yet in spite of the additional energy saved, the benefits to homeowner and nation, and the relatively small additional first cost, DOE selected the less favorable alternative on the basis of "the difficulty of achieving those levels at the present time." This reasoning is hard to understand if BEPS are to be a technology forcing regulation.

Standards for Non-Residential Buildings:

For non-residential buildings, the Department was unable to conduct the kind of life cycle analysis that they did on the single family dwellings. Therefore, the proposed rules are based on the older, technically-based data base collected by AIA/RC. Using the Phase II buildings redesigned by their original architects following the three day energy conservation course, the Department looked at three budget levels for such buildings. R_{30} means that 30 percent of all building redesigns for that building type achieved that level of design energy requirement or lower. DOE calls this "strict." R_{50} indicates that 50 percent met the figure; this is called "nominal." R_{70} means that 70 percent met that level of performance; this is called "lenient" (DOE's calculations reveal that for a large office building in Kansas City, these levels of performance translate into the following number of BTUs per square foot per year: R_{30} = 46 MBtu/sq. ft./yr; R_{50} = 49 MBtu/sq. ft./year; and R_{70} = 51 MBtu/sq. ft./year.) Again, in each case, DOE found that "the net present value to the Nation of the proposed Energy Budget Levels was greatest for the strict case and lowest for the lenient case. Thus, national economic benefits are greatest for the more strict levels." Likewise, DOE reveals that in a preliminary life cycle study of a large office building, "there are designs that are economically beneficial at design energy requirement levels more stringent than those achieved by most of the redesigns in Phase II."

Nonetheless, DOE feared that designers would have difficult in reaching strict levels not because of costs or technical constraints, but merely because of "unfamiliarity of design professionals with energy efficient design strategies and available technology." For this reason, DOE has selected the following levels:

- Large and small office buildings: R_{30} ("strict").
- Hospitals and multifamily low rise residential buildings: R_{70} ("lenient").
- All other commercial and multifamily residential buildings: R_{50} ("nominal").

Again, as a preliminary matter, it appears unwise to select standards on the basis that design professionals are unfamiliar with existing technology; a better strategy would be to set stricter standards and let the manufacturers, trade associations, continuing education course instructors, and the federal Energy Extension Service educate the professionals to meet the new, higher standard.

Sanctions:

Finally, in this description of BEPS, it is worth discussing how they will actually come to have the force of law at the state and local level. The building code professionals are conservative and clannish; from the beginning, there has been considerable distrust of the federal effort, and an active movement on the part of some states to have alternative energy conservation building codes in place in order to head off the federal BEPS when it finally emerged.

Unfortunately, Congress in the original legislation devised a Draconian remedy, one that is so excessive that it certainly would never be used. According to Section 305(c) of the Energy Conservation and Production Act, the President is to transmit the final BEPS regulations to Congress with a recommendation concerning their adoption. Congress then has ninety days in which to consider them. If both Houses pass a resolution approving the regulations, they become effective. Following that, any state that does not adopt BEPS or its equivalent, can lose all federal financial assistance for building. This includes "any form of loan, grant, guarantee, insurance, payment, rebate, subsidy, or any other form of direct or indirect Federal assistance" and "any loan made or purchased by any bank, savings and loan association, or similar institute subject to regulation" by the federal government or insurance by a government agency. This sanction is equivalent to sending policemen out in patrol cars, equipped only with fragmentation bombs: cutting off all federal aid to the building industry is too extreme a penalty ever to be imposed by Congress on any state.

We may hope that in its consideration of the standards themselves, Congress will try to develop a more graduated set of incentives and penalties for states that refuse to adopt BEPS or its equivalent. Training grants for state and local officials, incentive payments to state building agencies, educational efforts for the national code groups and voluntary organizations, and partial withholding of federal benefits are a better array of carrots and sticks with which to equip DOE.

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WHY ARE BEPS IMPORTANT?

Buildings are one of America's big energy users. The consume over one-third of all the energy this nation uses -- and they are profligate wasters of much of it! One recent study from Princeton University's Center for Energy and Environmental Studies found that leaking of warm air into attics from one and two story wood frame houses alone wasted over 600,000 barrels of oil per day, 2 percent of all the energy used in the United States. When one adds up the poorly insulated ceilings, the leaking window sills, the glass-box offices hot on one side and freezing on the other, it is little wonder that American buildings are the silent gas-guzzlers of the world.

They do not have to be this way. There are real houses, lived in by real families today that use 50, 60, or 70 percent less energy than their look-alike neighbors. In Denmark, there is a home that relies on the heat of the sun, the lights, and the occupants for winter warmth. Even in the long Danish winter, the house uses no energy at all specifically for heating. Life Magazine, in a year-end issue, devoted pages to modern, attractive homes that use clever designs to heat and cool themselves.

Offices present even greater opportunities for savings. A comparatively mild energy conservation regulation, ASHRAE 90-75, promises to cut office building energy consumption by almost 60 percent. Stricter standards would permit designers to build offices that function gracefully, comfortably, and economically with even less energy than the mild ASHRAE standard.

What is keeping us from building these energy efficient buildings, and how can BEPS help? Of course, there are a variety of factors that go into the design of a building, and many of those factors are practically impossible to regulate by any governmental action. Shoddy workmanship, careless siting on a lot that exposes a building to unnecessary heat or cold, and unreasonable desire to hold the initial cost of a building artificially low are influences that must be attacked by education, persuasion, and the effect of higher prices, not by direct regulation. But many of the excuses for avoiding a strong BEPS are just not true, or they are misleading. Let's look at some of the common misconceptions about BEPS:

- "It's impossible to build buildings more energy-efficient" - As we have seen, this just isn't so. What is true is that it is hard to change the way you have been doing things for years. A strong BEPS will give designers, sellers of stock house plans, architects, home magazine editors, and the rest of the building industry a strong incentive to discover (or, in many cases, re-discover) the ways to make buildings energy efficient.
- "Won't higher energy prices make buildings better without regulation?" - Of course buyers and renters are looking at energy prices more closely now than they used to. But for a new building -- the kind that BEPS regulates -- it is hard for even the most sophisticated buyer to know how energy-efficient the building will be. BEPS will provide a baseline so that every buyer will know that every building conforms to at least a good efficiency rating. (It is unlikely that BEPS will ever be so strong that conforming buildings will be as good as they could be.) BEPS will have the same healthy effect on the building industry that the EPA fuel efficiency standards have had on the automobile industry. The market and higher energy prices will work, but regulation can help them work faster.

- "Isn't this just another layer of government regulation?" - Regulating energy use in buildings is new, but regulating buildings and how they perform isn't new. Plumbing codes, electrical codes, fire safety codes, to name just a few, have been in existence for years. BEPS is likely to be administered by the same people who administer these codes, so no new government bureaucracy will be created.

- "The Regulation looks so confusing! How will it work?" - The intellectual underpinnings of BEPS are highly technical. These are what you see (partially) explained in the Notice of Proposed Rulemaking. But -- if the Department of Energy does its job correctly -- the rules that local and state building code officials will have to follow need be no more complicated than ordinary building code standards. The Conservation Foundation plans to monitor DOE's development of implementation regulations to make sure they can be administered in the real world.

- "Won't this add a lot to the cost of a house?" - It depends on whether you are talking about the initial cost of the house or the entire cost of owning it. It is true that BEPS will add a comparatively small amount to the purchase price of a house. But the savings on utility and oil bills will pay for that extra investment. Thus, the true, life-cycle cost of owning a home or any other building will be less.

In short, the idea of BEPS is a good one. But this does not mean that the regulations proposed by the Department of Energy are perfect. Far from it. Over the next few weeks, further BEPSGrams will explore strengths and weaknesses of BEPS, particularly as they affect environmental and conservation concerns. The criticisms should not be allowed to obscure this basic point:

> A STRONG BUILDING ENERGY PERFORMANCE STANDARD CAN DO MORE THAN ANY OTHER GOVERNMENT ACTION PROPOSED IN THE COMING YEAR TO SAVE ENERGY. IT IS WORTH DOING. IT IS WORTH DOING RIGHT.

December 31, 1979

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JUST WHAT DO WE MEAN BY ENERGY CONSERVATION, ANYWAY?

In the environmental community, the values of "energy conservation" are assumed with as little question as we assume the value of an unspoiled wilderness, a species preserved, or a clear blue sky. Yet we are notoriously imprecise in describing either to ourselves or to others what we mean by the term. As a result, we have let energy conservation take on an unpleasant, puritanical cast. When the President speaks on the subject, voters' minds turn to chilly rooms and endlessly slow drives through the desert in cramped little cars, rather than increased efficiency. In order to be successful in promoting energy conservation, we need ourselves to understand what we mean by the term, and what motivates people to conserve.

Prior BEPS Grams have dealt with the history of building energy regulation and the importance of the building sector in the overall energy picture of this country. Later BEPS Grams will turn to a much more detailed examination of the proposed regulations for the Building Energy Performance Standards program. But in this issue, we try to set out more carefully the goals we have for adequate conservation and how we think success can be measured.

There are at least three directions from which one can view motivations for energy conservation:

- The moral approach. Many people feel that it is their duty to save energy. Noting that America, with 6 percent of the world's population consumes 33 percent of the world's energy, they feel uncomfortable with this imbalance. Obligations are owed to future generations: will our appetites deprive our grandchildren of choices? Do we need this much energy to be happy? Wouldn't less be just as good?
- The engineering approach: Many people are displeased with wasteful practices and get pleasure from improving obvious inefficiencies. Leaks should be plugged because they shouldn't happen, powerplants should be bigger if larger ones are more efficient. This is the viewpoint that has motivated much of the work of DOE in conservation generally. Large "targets of opportunity" are selected, then engineers, designers, and inventors are turned loose to find technical fixes to the problem at hand.
- The economic approach: Many people observe that when the price of a good rises, consumers use less of it. In fact, prices serve as an accurate way of letting people decide how much of an item they really want when compared with other things they could spend their money for. Even better, prices let people figure out how to have the same things they want but at an overall cheaper cost to them! This view of energy conservation suggests that individuals' self-interests should be tapped for motivating conservation. The proper measure of how much conservation is sufficient for each individual is when costs equal benefits.

There is a great deal to be said for each of the three approaches, and any approach that promotes energy conservation in this society should be applauded. But for the purposes of setting government regulations, there are very good reasons for favoring the economic approach over the moral or the engineering approach.

Unfortunately, moral choices over how much energy others should use tend to be a poor basis for making government regulations. Consider your own feelings about some favorite energy-consuming object that is, for you, a necessity (e.g., a frost-free freezer, a dishwasher, or a station wagon). No doubt others have kidded you about one or another of your choices or you have ribbed a friend about some energy use they hold dear. This is just a microcosm of the problem that government would face if it tried to set conservation goals or standards based on guesses of what most Americans believed was right. Morals provide a powerful incentive for private actions, but regulations based on "you should" or "you must" can easily make poor public policy.

In the same way, the engineering approach is valuable, but gives no insight into when you have done enough conservation. There are always leaks to be plugged; an engineer set loose could spend more money than it is really worth in order to save energy. Another limitation of the engineering approach to energy conservation is that it assumes that the given way of doing things is relatively fixed or that people really want to pay for a given service when confronted with higher prices.

Thus, in our analysis, we will adopt the third outlook: the economic approach. Energy conservation, as we will use it, means taking those actions that result in a saving of money over the life of the building by permitting the substitution of one way of providing heating and cooling (e.g., a furnace/air conditioner) for another (e.g., better design, insulation, or heat exchangers). As the Ford Foundation-funded study, Energy: The Next Twenty Years says, "Money can be saved by substituting intelligence, prudence, maintenance, better equipment, or different equipment for purchased energy; the substitution should be made up to the point where the cost of not using the energy is equal to the cost of the energy saved."

There is considerable evidence that the economic viewpoint mimics the way people actually respond to changing conditions and the way they make decisions about their own purchases. People only infrequently make sweeping decisions that affect the use of large amounts of energy. Instead, they make decisions bit by bit, taking into account a wide variety of differing circumstances and competing desires. Price is easy to understand and exerts pressure on each of us every day as we make those thousands of energy-related decisions. Easier than understanding government prohibitions or another alphabet agency in Washington, price talks in a language we all know and respond to.

The economic approach has another strength: It is well studied and its limits are understood. This means that conservation arguments based on economics can be criticized from within the confines of a body of knowledge and an academic discipline. When the arguments stand up against such scrutiny, they are more likely to be accepted in a way that regulations based on someone's guess or best hunch would not be. Of course, in using an economic approach, one must acknowledge that energy is not traded in the classic free market setting. Far from it! Different energy forms are treated under different regulatory schemes. The cost of energy does not include the effect on the environment. Renewable resources are relatively unsubsidized by the government. Nevertheless, these shortcomings can be approximated and can be understood by policymakers.

Throughout the coming BEPS Grams, readers will see economics, cost/benefit analysis, life cycle cost analysis, pay back periods, and many other tools of economic analysis used as a measure of the effectiveness and stringency of the proposed BEPS rules. We adhere to this viewpoint not because we love economics, but rather because we believe that economic analysis provides a particularly searching tool for criticizing DOE's work. Use of this economic viewpoint is not meant to diminish the importance of looking at energy as a moral issue or as an area where technical fixes can help. But we believe that an economics-based analysis will demonstrate how much further the Department of Energy has to go in producing a satisfactory energy standard for new buildings.

January 31, 1980

Beps Gram

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A READER'S GUIDE TO THE NOPR

On November 28, 1979, the U.S. Department of Energy issued a Notice Of Proposed Rulemaking (NOPR) setting out the Building Energy Performance Standards regulations. As it appears in the Federal Register, the NOPR runs for 61 pages, 3 columns per page, in small type. Even though it is clearly written (at least by the standards of Washington), it is a document designed to daunt all but the most fearless reader -- or the reader with an economic interest in reading it. In this BEPS Gram, we will try to "walk through" the document, showing its organization and pointing out some of the most important sections for study.

The NOPR is divided into 8 major sections plus a summary at the beginning, a description of the Technical Support Documents (also at the beginning), and the Proposed Rule itself at the end. Each section is numbered; subsections within a major division are indicated by numbers following a decimal. Thus, section 4.3.7 is the seventh subdivision of the third part of the fourth major section of the NOPR.

THE SUMMARY

The summary briefly, though cryptically, tells the casual reader the subject matter of the material that follows. This summary responds to a requirement by the management of the Federal Register to give those scanning it a brief idea of what a rule is about. For the purposes of analysis, it is not important. In one important respect, the information contained in the summary is incorrect: the dates for the public hearings and the deadline for submission of written comments have both been changed. Please refer to our earlier BEPS Gram for the new dates. If you are going to participate in the public comment process -- either in person or by submission of written comments -- it is imperative that you follow the rules set out in the summary and the dates set out in the revision.

The section following the summary titled "Technical Support Documents" names the TSDs and gives the addresses of DOE offices where they may be viewed. It also promises that they will be available on December 19, 1979. According to a mailing from DOE received on December 31, the TSDs are still not widely available. Until DOE makes them more widely available, for all practical purposes they may only be viewed at the places listed in the summary. Future BEPS Grams will consider the material in the TSDs, analyzing it for persons who have neither the time nor the resources to devote to that task.

SECTION ONE -- THE STANDARDS PROGRAM

This section describes briefly the Standards and the elements of the proposed rule. Section 1.1.1 ("Summary Description of the Proposed Standards") is a good overview in a few paragraphs of the concept behind BEPS. It contains a description in a general way some of the important terms that recur in the Standards, including the Energy Budget Levels, the Design Energy Budget, and the Design Energy Consumption. Section One's overview is a good road map to the Standards; as you read through the document later and get lost in details, keeping the description of the big picture in mind will help. Conversely, do not let the apparent simplicity of the description fool you: BEPS contains many complications, and it is in the details that the most interesting questions may be found.

SECTION TWO -- THE RESEARCH EFFORT

This lengthy section describes how DOE framed the questions necessary for setting the Standards, the work it did in support of answering those questions, and the decisions that were made concerning that research. Although this section is somewhat technical, a careful reader needs to work through it in order to understand many of the limiting assumptions that DOE made in its research, assumptions that often result in weaker standards. The section begins with a description of the history of the research effort (sections 2.1.1 and 2.1.2). These sections acknowledge that the transfer of authority from HUD to DOE slowed down the Standards development process. In this section, note how the data base was developed by the AIA Research Corporation; the age of these data, in our opinion, severely limits the usefulness of that early work as a basis for setting standards for the 1980s.

Section 2.2 describes the research conducted to develop the Energy Budget Levels. These Energy Budget Levels are the targets, expressed in BTUs per square foot per year that every building of a certain type in a certain climate zone must meet. Clearly, setting the Energy Budget Levels is the very centerpiece of establishing an adequate BEPS. If the research base is weak or wrongly conceived, DOE will not have the materials necessary for sustaining a strong BEPS against challenges. Section 2.2.1 deals with the underlying research for setting commercial and multifamily residential Budget Levels; Section 2.2.2 deals with the research for setting Budget Levels for single family residences. In reading these two sections, compare how they differ in approach. For commercial and multifamily buildings, the Budgets were drawn from existing practice in the mid-1970s, based on the AIA/RC work described earlier; for single family dwellings, the Budget was drawn from an analysis of the lowest life cycle cost of building and operating the home.

Section 2.2.3 explains why DOE is not proposing standards for mobile homes at this time.

Section 2.3 indicates areas where DOE itself believes that its research base is weak. One of these areas, the issue of indoor air quality, is discussed in somewhat more detail in section 2.3.1. Basically, DOE concluded that they feared degredation in indoor quality if they tightened up buildings too much. A later BEPS Gram will discuss this issue.

Section 2.3.2 points out one of the most interesting gaps in the research program: that DOE has not looked at whether the standards they propose for commercial and multi-family buildings are effective in saving the maximum amount of money for the building owner. As this section notes, "the results of the preliminary life-cycle cost analysis of commercial office buildings indicated a potential for significant reductions in Design Energy Budgets below those derived from the" earlier research work. We believe that this is a major shortcoming of the proposed standards and deserves study and comment.

Section 2.3.3 sets out some unsettled questions about Energy Budget Levels for single family residences. This section discusses domestic hot water use (an area where solar energy can make an important contribution); new and innovative energy conservation options (where a technical breakthrough might increase conservation at little increase in cost); use of renewable energy sources; the effect of the Standards on masonry construction; and possible fine-tuning of the life cycle cost analysis techniques. In each of these areas, DOE specifically asks for the public's comments.

Section 2.4 looks at a variety of issues affecting the way the Standards are presented and used by those who must follow them. Several of the important issues are:

Weighting Factors: (Section 2.4.1) There has been a substantial disagreement concerning whether the BEPS should reflect only the energy actually used in a building (that is, the energy that would show up on the customer's meter) or whether it should also reflect both the energy used to make and distribute the energy and the social costs of a particular energy form. DOE originally used Resource Utilization Factors and Resource Impact Factors (RUFs and RIFs) to take these factors into account, but has now abandoned them in favor of weighting factors. This issue is of considerable economic interest to the electric industry, which fears that a high weighting factor for electricity will shift buildings toward using other fuels. The issue is also of considerable interest to conservationists, who see the need for some methodology -- like a weighting factor or a RUF and RIF -- as a means to gauge the total impact of energy decisions on the environment. A future issue of BEPS Gram will discuss weighting factors.

Renewable Sources of Energy: (Section 2.4.2) The statute setting up the BEPS program states that one of the purposes of BEPS is to increase the use of nondepletable sources of energy. However, the act also states that the Standards are not to set out any particular means for a designer to meet the budget levels: the BEPS are to be expressed solely as a performance standard for buildings. Thus, DOE cannot legally mandate the use of solar systems under BEPS; instead, various more subtle incentives must be put within the Standard. This section sets out the places where DOE has added renewable energy incentives in BEPS. Advocates of renewable energy will want to study this section carefully, asking whether the incentives are sufficient and whether further incentives (within the permissible confines of a performance standard) should be added.

Building Design Classifications: (Section 2.4.3) This section describes how buildings that fall between clear building types will be treated. Many new multi-use buildings (e.g., commercial buildings with apartments in them) are of this type.

Standard Building Operating Conditions: (Section 2.4.4) For the purposes of using computer analysis, DOE has established certain "standard conditions" which they assume for each type of building. Put differently, DOE's analysis assumes ordinary working hours, night thermostat setbacks, and so on. This requirement of a standard set of conditions is obviously wise; otherwise a building designer could "meet" the BEPS simply by stating that he was going to ask the building owner to keep the thermostats set to 47° in the winter and 92° in the summer! Because of the enormous variation in the way buildings are used, you will want to read this section to see if DOE's thinking conforms to your common experience.

Climate: (Section 2.4.5) A performance standard must take into account the climate where the building is located: a building in Duluth will use more energy for heating than one in Phoenix. This section describes the system of climate zones based on standard metropolitan statistical areas (SMSAs) and asks for information concerning whether these are either sufficiently detailed or over detailed for the final rule. Readers with technical training in the interrelationship between building energy consumption and climate may wish to comment on this subject. Readers may also find this section -- ignoring as it does the influence of solar radiation -- an appropriate place to consider adding more solar incentives. A future issue of BEPS Gram will consider the climate issue more fully.

Unit of Measure for Design Energy Budgets: (Section 2.4.6) This section asks whether the unit selected by DOE for BEPS (million British Thermal Units per square foot per year) is appropriate. We believe that it is appropriate and relatively easy to use in practice.

SECTION THREE -- SELECTION OF THE PROPOSED ENERGY BUDGET LEVELS

This relatively short (4 Register pages) section is at the heart of the BEPS: It is in this section that the Department of Energy announces what the budgets will be for various types of buildings and sets out its justifications for choosing one budget level rather than another. (A higher budget number is one that will be easy to meet but will save little energy; a lower figure is more challenging and more conserving.) The section treats commercial and multi-family residential dwellings separately from single family homes.

Sections 3.2 and following explain the figures picked for all buildings except single family homes. These sections explain that the selection is based on the early data-gathering work conducted by the AIA Research Corporation on buildings being designed in 1974-75. (Readers are referred to the history of BEPS that was distributed earlier for a more complete description of the shortcomings of that AIA/RC effort.) Briefly, the Department has set the proposed BEPS budget levels at what some of the better designers were capable of doing in the mid-1970s. Note that in Section 3.2.2, the Department admits that the savings for the nation and the net present value would both be greater at a stricter budget level. Also note the study referenced in footnote 47 of Section 3.2.3 indicates that the life cycle cost for office buildings would be lower if the standard were more strict. Yet, in spite of this material, DOE has selected relatively lenient standards. Their reason -- that "designers would experience difficulty in reaching the strict range of design energy requirements" -- deserves careful examination.

Note in reading these sections that certain commercial building types are not to be regulated because of technical difficulties in dealing with so-called "process energy," that is, energy produced by a major heat producing activity within the building. Examples of process energy are the heat produced by the grill in a fast-food restaurant or by the forge in a steel mill.

Note also the comparisons between existing standards and the proposed BEPS contained in Section 3.2.9. This indicates that even with the relatively constrained budget levels picked by DOE, the new BEPS would be better than either the HUD Minimum Property Standards or the ASHRAE Standard 90-75 (adopted by many states). Readers may hear that BEPS is not needed because their state "already has an energy code based on ASHRAE Standard 90-75." The preliminary comparisons in Section 3.2.9 indicates why even a flawed BEPS is a great improvement on existing standards.

Section 3.3 and following explains the energy budget figures picked for single family homes. Briefly, DOE decided to set the standard for single-family homes at the minimum life cycle cost. (A future BEPSGram will analyze the requirements of a satisfactory life cycle cost analysis and describes in what respects DOE has deviated from such an analysis.) Again in the course of this part of the NOPR, note that DOE admits that a tighter standard would save more energy and save money, yet they have chosen a more lenient standard. Important issues for readers to consider are whether the additional first costs (see section 3.3.4) are substantial in view of the energy savings (section 3.3.1); whether the Department's arguments about practicality (section 3.3.3) are convincing; and whether the possible degredations in of indoor air quality (section 3.3.5) can be avoided by some technical fix. Table 3-1 is the only place in the NOPR where the average reader can get any idea about what effects implementation of BEPS would have in actual construction. Readers may be surprised at what comparatively modest changes are required in housing design or construction to achieve enormous savings. But the table leaves one with the gnawing suspicion that if it is so easy to save some energy, surely it ought not be so terribly hard to save even more!

SECTION FOUR -- BUILDING DESIGN EVALUATION TECHNIQUES

This section of the NOPR will be the delight of those interested in the strengths and limitations of computer simulation techniques. As the introduction (section 4.1) points out, there will be two ways for BEPS to be applied in practice. The first way is to apply computer models to a given design to predict whether the building design will use less energy than permitted for such a building type in such a climate. The second way is to construct a building that complies with a model code that has been pre-certified to comply with BEPS. Thus, this section of the NOPR deals with two issues that are crucial to the success of BEPS: (1) creation of a computer model that can take the blueprints of a building and predict how much energy per square foot per year that building will use, and (2) figuring out ways to change existing energy conservation codes and standards (or to create new ones that will be simple to follow) so that buildings constructed according to the code will also comply with BEPS.

Computer analysis: For the purposes of BEPS, DOE is proposing to create a Standard Evaluation Technique, which is simply a computer model with a set of fixed parameters for climate, building operating conditions, and other conditions. The Standard Evaluation Technique will be in the form of a computer program designed to take blueprints of a proposed building in a given location and calculate the design energy consumption. In section 4.3, DOE proposes that the Standard Evaluation Technique be three computer programs called DOE-2, TRNSYS, and DEROB.

For those readers who are interested and experienced with computer modeling or energy consumption predictions, we recommend that you obtain a copy of Technical Support Document No. 1, The Standard Evaluation Technique. Future BEPSGrams will touch on various issues raised in TSD #1, although a complete analysis of that document will not be part of the BEPSGram series. A brief description of the use of the Technique may be found in section 4.3.3.

Section 4.4 discusses alternative techniques for evaluating buildings. DOE notes that although it is going to suggest computer programs, it is also willing to let others develop their own computer techniques (or even techniques suitable for use on a hand held calculator or with paper and pencil) that can take a building at the design stage and estimate its energy use. DOE announces that it will establish a test to make sure that these other techniques give the same results as its own computer program; if they do, these alternate techniques will be certified for use.

Modifying existing energy codes: In this section of the proposed rule, DOE fails to mention what many believe is the most significant issue in deciding whether BEPS will succeed: simple, easily understood methods for changing existing codes (such as the ones based on ASHRAE Standard 90-75) so they will conform with BEPS. Figures demonstrate that the majority of buildings in this country are built not with the help of professional designers, but rather use standard plans drawn by a professional "plan service" and sold or from plans developed by a contractor with little or no formal design training. This means that the bulk of new buildings will not be subjected to the computer analysis, but rather will follow a "cookbook" approach. Thus, if BEPS are to be a success in practice, it is imperative that existing model codes be modified, that services providing standard plans to builders receive assistance in changing their standard designs to meet BEPS, and that manuals of acceptable practice and other standbys used by the construction trade are brought into line with BEPS. Failing this effort, BEPS will be a failure in practice even if they are a triumph in theory.

The remaining parts of section 4 deal with relatively specific issues concerning the Standard Evaluation Technique. Again, because of the importance of this issue to the reliability of the Standards, we urge those readers who are able to do so to comment on this section.

SECTION FIVE -- IMPLEMENTATION

Under the statute, regulations affecting implementation of BEPS are to be produced after the Standards themselves are complete. This is unfortunate. The Standards and their implementation are intimately bound together, so that bad Standards might be easy to implement, while good Standards might be impossible to enforce. In either case, a great deal depends on the relationship between the two. Unfortunately, in law at least, development of the implementation regulations is still divided between the Department of Energy and the Department of Housing and Urban Development. Although the two federal agencies have agreed that DOE will develop the implementation regulations, the legal division continues as an irritant that only legislation can correct.

Section 5.2 sets out the statutory requirements for the implementation plan and describes the sanctions for any unit of government that fails to comply with BEPS -- but if and only if Congress approves the need for sanctions. In a later BEPS Gram, we will discuss the issue of sanctions, presenting our view that the sanctions are too inflexible.

Section 5.5, State Certification, describes DOE's preliminary thinking concerning what constitutes an acceptable state code that would be in compliance with BEPS. Basically, DOE finds that states themselves should certify to the federal government that their energy codes comply with BEPS, although the federal government can monitor whether or not the certifications are correct. This section also discusses briefly one of the most complex issues raised by BEPS: that is, how can to tell whether a given code is "equivalent" to BEPS. "Equivalent" means that any building that complies with the code under consideration would also comply with or exceed the requirements of BEPS. DOE describes how it will assist states in determining whether codes are "equivalent." First, DOE proposes to pre-qualify various codes that are widely used. (These would probably include a version of ASHRAE Standard 90-75 and several other widely-used codes.) Second, DOE proposes an alternate approval process (described in Section 5.4.2). This would permit states that did not wish to use a pre-qualified code to continue issuing building permits with confidence that they were complying with the Standards.

The information given in Section 5 of the NOPR is insufficient to evaluate whether DOE has intelligently designed an implementation strategy. Moreover, at a later date, the Department must produce actual proposed regulations on the subject. We plan to provide assistance to environmental and conservation groups in commenting on those later regulations. Therefore, we suggest that comments on the implementation materials at this stage be limited to observations of the importance to the BEPS program of good implementation, withuut too much detailed commentary on the materials contained in Section 5.

SECTION SIX -- OTHER MATTERS

This section of the NOPR is a grab bag of items. Section 6.1 describes the availability of the draft environmental impact statement; Section 6.2 describes the regulatory analysis, and so on. The materials contained in this section do not require comment; the underlying documents (the Technical Support Documents) will be analyzed in future BEPS Grams.

SECTION SEVEN -- OPPORTUNITIES FOR PUBLIC COMMENT

You should follow the exact procedure set out in this section if you wish to comment in writing or at a public hearing. Note, however, that the dates of the hearings and the closing date for written comments has been extended, as noted in an earlier BEPS Gram.

SECTION EIGHT -- A GUIDE TO THE PROPOSED RULE

This final section of the NOPR (just prior to the actual rule itself) describes how the BEPS process would actually work when applied to a building. It is a good exercise to read carefully though all of Section 8 to make certain that you understand what a designer would do to comply with BEPS. The illustration used in Section 8 is the performance path; in fact, we predict that almost all buildings will use an equivalent code so that complying with BEPS will be no more complicated than complying with a plumbing, electrical, or ventilation code. But Section 8, using the more complicated performance path approach, gives an idea of the worst case for the builder.

If you followed your way through Section 8, you have a good working knowledge of the Standards and how they will be applied!

THE PROPOSED RULES

The NOPR ends with the legal text of the rules themselves. The heart of the rules themselves are the Energy Budget Levels that appear near the end of the proposed rule. The figures are expressed in terms of millions of BTUs per square foot per year; Table I-1 is for single family homes (both detached and attached); Table I-2 is for domestic hot water for single family homes; and Table I-3 is for commercial and multi-family residences. In case of both Table I-1 and I-2, note how the figures vary by climate region.

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Readers may wish to save this issue of BEPS Gram as a reference to be used as later, more detailed issues are raised.

February 6, 1980

Beps Gram

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BEPS and the Art of Life Cycle Costing

Understanding the concept of "life cycle costs" is the key to understanding energy conservation. Life cycle cost (LCC) analysis lets us decide how much money it is worth investing now in order to avoid incurring higher operating or maintenance costs later. Instead of focussing narrowly on the initial price you pay, LCC analysis is an orderly way of deciding whether you should spend more at first to avoid a higher overall expense over the life of the item. Let us suppose you are thinking of buying a car. Two models appeal to you. The Hupmobile costs $4,000 and gets 7 miles per gallon. The Svelte costs $5,000 but gets 42 miles per gallon. Both cars will sell for the same price after you have owned them for one year. If you know that you always sell your car after one year and that gas costs $1 per gallon, it doesn't take much mathematics to figure out that the Svelte is a better buy if you are planning to drive more than 8,400 miles that year. Thus, the extra $1,000 spent at first pays for itself later.

In exactly the same way, a person trying to decide whether to spend a little more on a house, an office building, or a factory should calculate how much extra to invest at first (in better insulation or better design work for example) in order to save money later on fuel. Ideally, the Building Energy Performance Standards should be set in order to minimize the life cycle cost of owning a building. This BEPS Gram deals with how the Department of Energy (DOC) has used life cycle cost analysis for setting the single family family residential standard. We strongly support the concept of using life cycle costing for setting energy conservation standards. In fact, a major shortcoming of the BEPS as proposed is the limitation of LCC analysis to the single family residence: we believe the analysis should be extended to all buildings. But even for the single family residence, there are flaws in the LCC analysis that should be corrected.

How Do You Do An LCC Analysis? To perform an adequate LCC analysis, six steps must be taken. These steps are widely recognized and are used, among other places, by the National Bureau of Standards. The steps are:

1. Choose those things in your analysis that you don't want to change ("the constants").

2. Choose those things you are willing to let change ("the parameters") and decide how much you will let them change ("the range of each parameter").

3. Decide how long a period is appropriate to analyze ("common time basis").

4. Determine how you will measure costs and benefits of the changes you are analyzing.

5. Quantify those measures to arrive at life cycle costs.

6. Compare the various design options for both costs and benefits to determine which action or set of actions you should take.

Let's look at how this six-step process was used by DOE and where it went wrong.

Choose Constants

DOE has assumed that some things must remain constant among all the different design changes they analyzed. For example:

- Every house is designed so that there is exactly 15 percent as much window area as there is floor space.
- Every house has an equal amount of window area on each wall.
- Every homeowner sets the thermostat at 70° and never changes it.
- No one uses more than triple glazing in windows.
- Every homeowner uses natural ventilation to keep the indoor temperature below 78°. If this is not possible, everyone uses air conditioning.
- No one uses wood stoves, room air conditioners, dehumidifiers, or fans (or other "user-operated devices").
- No one every changes the heating, ventilating, or air conditioning system in a house, no matter how relative fuel prices very or effiencies of those devices improves.
- No one makes any changes in the lighting, air infiltration or other building comfort levels from certain levels assumed by DOE.

All of these limitations make it harder to save energy. For example, common sense and scientific studies both emphasize the importance of clustering windows on the south side of homes to take advantage of the warmth from the winter sun. Yet by artificially assuming facts that don't exist, DOE's LCC analysis isn't really looking at a complete set of reasonable alternatives for energy conservation.

The Department should have examined a much wider variation in conditions. What if people used four-ply windows? What if all furnaces came equipped with automatic night-setback thermostats? What if BEPS were set in order to force builders to shift more windows to the south side of the building? In each case, the Department would have found many reasonable alternatives for energy conservation that would substantially lower the life cycle cost of owning a home -- and would have saved considerable energy while doing it.

Choose Parameters and Their Range

The next step in an LCC analysis is to choose the paramenters you are interested in changing and to choose the range within which each will vary. A selection of the values of each parameter will specify each design alternative used in the later analysis. DOE uses four parameters. The first is the cost of the labor involved in designing and building a house. The second is the quantity of materials used to build and maintain the house. The third is the number and size of the heating, cooling, refrigerating, cooking, and lighting fixtures used. The fourth is how much energy the house will use for performing the "services" people require: keeping warm and cool, preserving and preparing food, and lighting.

To be sure, these parameters are the appropriate ones to consider. But in order to analyze DOE's figures, they should make available the range they have chosen for every one of the parameters and the different designs resulting from the choice of the value of each parameter. Unfortunately, the Proposed Rule does not give this information. The Technical Support Document where you would expect to find the information

(TSD #8, Economic Analysis) provides incomplete or contradictory information. Thus, it is impossible for an outsider to follow the trail of DOE's analysis from the information it has made publicly available.

Choose a Common Time Basis

One must look at two specific time periods in order to do an LCC analysis. The first time period is the life (in years) of the capital assets (in this case, the house and all of its appliances and fixtures), so that all present, past, and future contributions to those assets can be compared with one another without ambiguity. The second time span is the study period or the amount time the homeowner is going to live in the house and enjoy directly the benefits of the investment. If this study period is less than the life of the assets, you need to calculate a "salvage value" for the purposes of the assets. Recall that both the Hupmobile and the Svelte sold for the same price after one year. Therefore, in our analysis it was unnecessary to take the salvage value of each car into account even though our study period (one year) was less than the life of most automobiles. For houses, there is considerable evidence that conservation investments actually add to the salvage value of the house; put differently, energy efficient houses sell for a higher price than leaky, drafty houses.

DOE assumes that both the asset lifetime and the study period are the same: 30 years. This assumption can only be based on a belief that all of the fixtures that contribute significantly to the cost of a house will not be replaced for 30 years. Most homeowners do not have such a happy experience: instead, they replace, upgrade, improve, and redo. Moreover, for many of the important energy conserving features (insulation, caulking, furnace improvements and so on), common experience shows that 30 years is too long. Finally, because most people move several times during a 30 year period, the increase in market value that an energy conserving house enjoys is an important consideration for life cycle cost analysis.

DOE should have taken all of these important factors into account in its LCC analysis.

Determine Measures for Costs and Benefits

In order to decide whether a particular investment in conservation is worth it, you need to change the costs of that action and the benefits you receive from that investment into a common measure. The customary measure is dollars spent and dollars of comfort received. Both sides of this equation present difficulties.

The estimations that DOE makes for the costs of energy conservation systematically tend to overinflate the price. For the initial investment, the Department started with its "prototype house" and then calculated the additional costs needed to include various conservation features. This "add-on" approach makes conservation options appear more expensive than they really are. In fact, many of the most cost-effective energy conservation features -- such as design changes or items built in rather than added on -- are very cheap to do at first. DOE should have used a variety of prototype houses, designed from the first with energy conservation in mind.

DOE assumes that no matter what design of a house you use, you obtain the same benefits (that is, the same level of comfort). DOE should have made some attempt to deal with changing levels of benefits to account for different tastes explicitly. The inclusion of more of these benefits would have made energy conservation appear to be a greater bargain than DOE is willing to admit.

Quantify Measures

In order to bring all the costs down to their present value for the LCC analysis, we need to predict the levels of future fuel not used and we need to decide how much money saved or spent in the future is worth now ("discount rate"). Both of these issues will be treated in a future BEPS Gram.

Compare Options and Decide

The final step in performing an LCC analysis is to compare the present costs and benefits of different designs. The design that has the most benefit for the least present cost is called the "LCC minimum" design. DOE presents designs that are lower than their minimum. This point needs to be clarified by the Department.

We recommend that BEPS should be set at the LCC minimum that also provides benefits within acceptable comfort tolerance levels. As energy conserving technology for buildings improves, and as energy prices rise in the future, BEPS will also become stricter as the LCC minimums decrease. Thus, the Standards will provide a cost-effective means of saving energy for any building owner.

Summary

Life cycle costing is absolutely essential for an intelligent program of energy conservation for American buildings. But the process of performing such an analysis is complex. The complexity arises out of the complexity of life itself: no computer model or study can capture all of the variations that are possible in buildings. Nonetheless, the simplifying assumptions that run through DOE's work appear to bias BEPS away from energy conservation. A program as important for the future of the country deserves a more careful look to make certain that every reasonable step is taken to encourage more energy efficiency, not less. Judged against this standard, DOE needs to make further revisions in its LCC work for single family residences and to apply the same philosophy to all other buildings.

OOOPS! In the BEPS Gram entitled "A Readers Guide to the NOPR," the unit of measurement for Design Energy Budgets was mistakenly stated to be millions of BTUs per square foot per year. The correct unit is thousands of BTUs per square foot per year. Please make this correction in your copy.

February 11, 1980

Beps Gram

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AND NOW A WORD ABOUT COMMERCIAL BUILDINGS

When most of us think about energy use in buildings, we instinctively think of our own home, its insulation, furnace, and thermostat. This bias is natural, since we all live in some kind of home. Yet there is another important world of buildings that our residential bias obscures: this is the world of the large commercial building, including the large apartment house. Half of all the energy used in American buildings is consumed in just such buildings: if we ignore them, we will miss half or more of our opportunities to save energy.

The basic fact about energy consumption in these large buildings is that it varies enormously from type to type and even within buildings of the same general type. Schools, hospitals, factories, restaurants, apartment complexes: there are few generalities that hold true in many cases. The government was aware of this problem and decided to select the design drawings of a number of buildings, analyze them by computer to estimate their predicted energy use, and then use that computed data as the basis for setting commercial building standards. The story of this work by the AIA Research Corporation (AIA/RC) has already been told in a previous BEPS Gram; the important points to remember are that the standards are based on buildings designed in the mid-1970s, and that no real buildings were actually considered, only computer predictions of building designs. To understand this research, we must trace the assumptions used in the computer models. These assumptions must be examined to make certain they are both reasonable and consistently applied.

Unfortunately, following the thread of these assumptions through the documents provided is a difficult task. In the Notice of Proposed Rulemaking, the reader is referred to several Technical Support Documents (TSDs). TSD #2 covers the initial statistical work done by AIA/RC and others on the designer sample. TSD #5 ("Standard Building Operating Conditions") contains the assumptions made by DOE on how buildings use energy. TSD #1 describes the "Standard Evaluation Technique," that is, the instructions on how to take a building design and calculate predicted energy use. At the back of TSD #1 (Appendix V, part A) are instructions on how to run the appropriate computer programs to calculate the energy used in each design from the assumptions given in TSD #5. Finally, one can look to Appendix B of TSD #8 ("Economic Analysis") to find the "net cumulative energy savings to the Nation" and the "value models." These two quantities compare the effects of different standards and choose the best standards for the Notice of Proposed Rulemaking.

The analysis thus spread over these documents deals with important questions, but unfortunately, it fails to ask the questions that should be central in any discussion of energy conservation: "What will it cost and how much will it save?" (The importance of framing energy conservation questions in this context is the subject of an earlier BEPS Gram, "What Do We Mean By Conservation Anyway?") By failing to gather the data necessary to conduct a life-cycle cost analysis, the Department has been forced to set standards on the basis of estimations about work that some designers did in the mid-1970s, rather than what is good for the Nation in the 1980s. In the time since the designs were completed, energy prices have risen rapidly and further rises appear highly likely. These changes call for better data collection -- especially data collection on costs and benefits in various types of commercial buildings -- if this part of the BEPS is going to save as much energy as it should.

Many improvements could be made in the Department's analysis. In fact, DOE has already recognized some of the major shortcomings in its commercial building analysis. The Department is currently performing life cycle cost analysis for these buildings. Unfortunately, it is unlikely that this improvement will be available in time for the final rulemaking due in August, 1980. Nevertheless, BEPS as they stand now can save a significant amount of energy in commercial buildings. Because of this, DOE should consider issuing the standards with the best information available, and make a commitment to update them rapidly on the basis of its further research. In this BEPS Gram, we discuss the statistical analysis of commercial buildings that are found in the TSDs; later BEPS Grams will consider other issues affecting both commercial and residential buildings.

Statistics is a systematic mathematical method to help us understand relationships between events occuring in the real world. The method is particularly valuable when those relationships are presently unknown or not, well thought out. Application of the statistical method requires us to make a series of assumptions (called "hypotheses") and to collect information on what is actually happening (called "data"). Then statistical tools let us work with the data to test whether those data support our hypotheses. If they do, we have not proved that the hypotheses are correct. With a sufficiently large amount of data and with very high correlations between what we observe and what we predict will happen, we can become increasingly confident that our hypotheses are correct. Statistical methods are perfectly suited to studying the energy use in a large building if there are enough data and if those data allow us to test all the important hypotheses.

The statistical analysis of BEPS is quite defective when measured against the complexity of the relationships being studied and the need for an adequate amount of data. The sample size is small, thus limiting any conclusions about the designs sampled. In order to make up for this, data are subjected to a variety of techniques that help the data "fit" various relationships assumed by the researchers. Such fitting amounts to doing your high school chemistry lab experiments backwards: you know the "answer," so you have to get back to the "data" needed. Unfortunately, commercial buildings are no two-chemical lab problems; they involve complicated relationships among heating, lighting, occupancy, ventilation, and climate. Therefore, this manipulation of data points, even by "powerful and sophisticated statistical methods" should make one uneasy.

A valid statistical methodology is to make simplifying assumptions either where you don't know the data or where data is expensive or difficult to obtain. But where many simplifying assumptions are made, those simplifications tend to make the relationships generated by later analysis less reliable. For example, in TSD #5, temperatures, occupancy levels, lighting, ventilation requirements, and exhaust fan use are all given fixed levels. No real explanation is given for these assumptions other than "the nature and intensity for energy use may vary widely over the useful life of the building." Likewise, in TSD #1, "Standard Evaluation Technique," there are no provisions for buildings using passive or active solar systems, commercial buildings with more than one furnace and air conditioning system, and other commercially available systems. It is one matter to make simplifying assumptions that can increase insight into a difficult problem; DOE's approach, unfortunately, goes well beyond this so that little insight is gained.

The final stop along the faintly marked TSD statistical trail is a slim appendix to the economic analysis. This appendix contains an evaluation of the economics of new commercial construction, as influenced by BEPS. Again, this appendix is flawed since it does not use life-cycle cost analysis. Totalling up the energy saved from buildings (whose performance was basically calculated from the beginning) is limiting to one's explorations of different conservation options. A more complete look at these options is needed and might have been provided by using an LCC calculation. In fact, in one footnote in the NOPR, DOE refers to a preliminary draft of an LCC study on an office building. That study confirmed that for that office building at least, an LCC study would result in much stricter standards. It is hard to avoid wondering if that one office building isn't trying to suggest a truth that applies to all commercial buildings.

Even as they stand, BEPS will improve energy use in commercial buildings. But it is a shame not to do the job right.

March 7, 1980

Beps Gram

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WHAT WILL ENERGY COST IN 1990?

The Department of Energy's Energy Information Administration (EIA) has tried for many year to calculate what energy costs present day consumers and what it will cost consumers in the future. This simple-sounding task turns out to be quite difficult in practice, and in practice the EIA has almost universally underestimated these costs.

For BEPS, this underestimation of the price of fuels affects two crucial calculations -- the determination of the weighting factors and the calculation of life cycle costs -- and in both places it has the effect of making the standards weaker than they should be. "Weighting factors," which are the subject of a future BEPS Gram, basically are used to let designers know that a BTU of oil consumed in a building is not the same as a BTU of electricity or a BTU of natural gas used at the building. For example, because it takes three units of coal or uranium or oil to produce one unit of electricity delivered to a house, counting the BTUs of electricity the same as oil would seriously understate the resource impact of electricity. Weighting factors are based, in part, on the price of different fuels as calculated by the EIA. If the price is too low, the weighting factor will be too small. In a different fashion, incorrectly low energy costs discriminate against conservation in a life cycle cost analaysis. Life cycle costs (which were discussed in an earlier BEPS Gram) depend on good estimations of future fuel costs; without good predictions it is impossible to decide how much it is worth now to invest in energy conservation to avoid higher fuel bills later.

Calculating the Present Cost of Energy

It seems hard to believe that the EIA does not know the present price of fuels. Couldn't they just go around the country and ask what people are paying? And of course they do. Yet asking what today's customers are paying for their energy is the wrong question when we are looking at energy conservation. Almost all fuels consumed today are a mixture of inexpensive energy already located and expensive energy yet to be discovered or produced. For example, electricity in the Pacific Northwest is produced mainly from hydroelectric sources that are quite cheap. Yet if many new buildings hook up to the grid there, the region will have to add coal or nuclear powered plants, costing more than old dams and producing much more expensive electricity. Therefore, from the nation's point of view, the relevant question is not what the cost of energy is to today's consumer, but rather what the cost of the new energy is: it is those costs that can be incurred or avoided by conservation actions. That is the price that will have to be paid, so it is the one to focus on. Economists call this the difference between looking at the average costs and the marginal costs of energy.

Often the marginal cost of energy is much higher than the average cost. The Ford Foundation sponsored study, Energy: The Next Twenty Years, used $75 per barrel for present day marginal costs and $25 per barrel for the average costs. The difference in costs reflects the fact that oil is getting more difficult (that is more expensive) to dig up, drill out, convert to electricity, or to send over the wires to the end user. Most conservation investments must be made at marginal costs instead of average costs; comparing the average price of energy with the marginal cost of conservation puts conservation at a severe disadvantage which the country can ill afford.

Why does DOE use the average cost in BEPS? The Notice of Proposed Rulemaking notes "that replacement costs are the most appropriate indicator of the cost to the nation of producing new sources of energy for new buildings . . ." Henry Kelly of the Solar Energy Research Institute states that "the national objective must look at the marginal cost, not the average cost." The Harvard Business School study, a recently completed Stanford University study, and many other sources are uniform on the need to use marginal costs in analysis, if not in the market itself. DOE, in its own defense, states that marginal costs "were not available in time" from the EIA to use in the proposed rule. Rather than estimate any marginal costs, DOE used available information, a process somewhat similar to waiting a long time for a bus on Sunday morning, then taking the first one, even though it is going the wrong direction, just because it's available.

Even in calculating the present-day prices, DOE took the process of price averaging one step too far by producing a national average of fuel prices. This average masks important regional and local differences in prices. The national average in effect pretends that all parts of the country pay the same price, something that is manifestly not so. DOE must be encouraged to move away from a national average and toward a regional or even a local marginal cost estimate.

Predicting future energy prices

It is hard to forgive EIA its inability to develop present marginal costs of energy. However, we can be more charitable about its consistent underestimation of the future costs of oil. No one could have guessed the timing or the magnitude of the changes that have taken place over the past decade. But what we have learned ought to lead us and EIA to believe that the prices will continue to rise, probably faster than we like or expect.

After the Arab oil embargo, EIA's predecessor agency (the Federal Energy Administration) created a mathematical model of the nation's energy system to help it make energy price predictions. The model, still in use in modified form, uses 10 regions of the country and establishes an interrelated network of supply and demand equations to determine what price a fuel must command in the market place in order to bring supplies into balance with demands. A major input to the model is the so-called "supply curve" for each fuel. A supply curve tries to describe mathematically how much of a given fuel will be available at a given price. Some of these curves are extremely complex; all of them depend on predictions for which past available data gives little guidance. Yet even so, the model must approximate all but the most simple relationships in these supply curves to permit even a very large, very fast computer to solve the many equations within a reasonable amount of time.

Predictions are incorporated into the model by changing the supply curves (as well as certain other inputs). These changes are often based on human judgment, as indeed they must be, since none of us can know the future. Yet it is important to lay out the basis for those judgments so that others can know whether they agree or disagree with them. Unfortunately, these crucial judgments are not referenced for the BEPS reader.

Naturally the future -- particularly the energy future -- is hard to predict. But the Department has a sorry record indeed. In 1975, it predicted world oil prices at $11 per barrel in 1985. The current prediction for 1985 is $30 per barrel (roughly today's price, not 1985's price). These numbers are typical of the too-low forecasts. DOE must attempt to improve its forecasting abilities, because so much crucial planning depends on it. It should also make the underlying assumptions more transparent.

The changes discussed here are not radical, they are simply the basic stuff of good analysis. Marginal cost predictions will give us regulations that truly save the nation as much energy as it is worth it to all of us to save, not a bit more nor a bit less. Better, more realistic predictions of future energy costs might throw the cold light of reality onto those who believe we can go back to an era of cheap fuels and leaky houses.

March 17, 1980

Beps Gram

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LET THE SUN SHINE IN

> For heat, humidity, fresh air -- all the elements that make up interior comfort -- the problem is pretty simple: keep it in or keep it out, let it in or let it out. These aren't new problems; man has spent his history as a builder learning how to deal with them. But sometimes in our headlong progress we forget the old lessons.
>
> Progressive Architecture

The regulations proposed by the Department of Energy for BEPS seem at times to forget the wise old lessons. Everywhere one looks today, builders are using techniques of solar design: adobe walls for thermal mass, deciduous trees for summer shade, large south-facing windows, and overhangs calculated to shade out the summer sun and let winter warmth enter. Almost every issue of the leading home magazines includes an article on active or passive solar design. Yet DOE has failed to capture the richness and variety of solar energy use in designing its BEPS. Instead, throughout its analysis, DOE has defined solar techniques narrowly, ignoring many common strategies that are already widely used. In its life cycle cost analysis for single family homes this omission is particularly disturbing. Perhaps even more troubling, DOE has failed to live up to its statutory mandate to encourage the use of renewable resources. Finally, there is little indication within the confines of the Notice of Proposed Rulemaking that the Department will give sufficient emphasis to educating commercial and residential builders about the many opportunities for saving energy that solar energy will permit. In this BEPSGram, we discuss some of the corrections that should be made in BEPS to truly capture solar energy's potential.

Narrow Definition of Solar Energy:

To understand what the Department means by solar energy, one must look at the Technical Support Document Number 9, "Passive and Active Solar Heating Analysis." (This document concludes, it might be noted, that passive solar systems are not viable in Portland, Oregon, a place where there are a number of solar homes that are operating efficiently and economically!)

In TSD #9, heating with the sun, while using the same materials to provide "coolth," is completely ignored. A concrete wall, correctly placed, can absorb the winter sun, releasing it through the evening hours. In the same way, it can radiate heat off in the cool of the night during the summer, then be available all day as a cool block to absorb heat inside the shaded home. Acting like a giant thermal flywheel, such thermal mass, incorporated into the building structure from the very design stage, is cheap to build and free to operate. Yet the Department completely ignores thermal mass in its analysis.

Ignoring thermal mass may be a simple omission, but the narrow vision of solar energy's potential pervades the document. For example, the TSD assumes that:

- Every heat-exchange medium uses only liquids for space and water cooling, thus ignoring most cost-effective methods which use air or other gases.

- All windows used as part of a passive solar energy system are assumed to be double glazed, no matter what other glazing is appropriate for the remainder of the house in the climate zone.
- Only concrete foundations on-grade are used.
- The appearance of the house may not change, even if relatively modest changes in the appearance of the house would substantially reduce the overall cost.

This final point severely limits the options of designers. Almost quite ordinary tract-type homes are now being built throughout the country taking advantage of window overhangs, south-facing window, and other techniques to cooperate with nature. Indeed the Leger houses in Massachusetts are examples of suburban homes that appeal to ordinary families, can be afforded, and actually "make" money for their owners because they are so cheap to heat. The innovations are all in the care with which they were designed beforehand. Buyers in East Pepperell line up to purchase them.

In addition to ignoring many solar techniques that are already in common use, the TSDs make inaccurate assumptions on others. These inaccuracies prevent solar energy from being used efficiently and economically. In an appendix to the TSD #3 on "Energy Budget Levels," for example, the hot water inlet and outlet temperatures are assumed to be 50°F and 140°F. Yet a lower outlet temperature and a higher inlet temperature can be effectively provided by solar hot water heating. The smaller range of temperatures is probably more typical in homes than DOE's own assumptions. Likewise, DOE simply assumes that every resident uses 63.4 gallons of hot water per day, an assumption surprising in its accuracy in view of the fact that no source is cited.

The Department should correct or verify these questionable assumptions and incorporate as many different solar techniques as possible into their analysis. Such a revised analysis might help DOE amend its the astonishing statement in the NOPR that solar designs "have not achieved widespread acceptance by the design community or the building industry."

Life Cycle Cost Analysis Must Be Improved:

The narrow range of solar techniques analyzed results in a defective life cycle cost analysis. As pointed out in an earlier BEPS Gram, life cycle cost analysis ought to consider the entire range of conservation and solar energy options in order to determine the minimum costs that could be incurred by the owner. Instead, the DOE analysis assumes that the buyer begins with an already designed and built building, then various conservation and solar afterthoughts are added to the building. These alterations are obviously more expensive than if the designer had started out with the solar techniques at the beginning of the design process and included them from the start.

Sadly, DOE's life cycle cost analysis also fails to take advantage of the many profitable interactions between conservation and solar techniques. Instead, the approach taken is like walking through a cafeteria line, taking tasty items until you have spent your money. Planning certain conservation and solar items together might avoid assembling a meal of chocolate pudding, strawberry pie, and grilled zucchini! You should never think of using south facing windows without also insulating the attic; unless the analysis considers this as a package, the collection of random techniques fails to make sense in the real world.

BEPS Energy Budgets Should Be Designed to Encourage Solar Energy Use:

One of the most hopeful promises of the BEPS program when Congress enacted it was that it would serve as a means to encourage a move to a Solar America in our new buildings. Many observers believed that if the DOE simply set the energy budget levels sufficiently strict, designers would find that they no longer could simply slap a few inches more insulation in the roof and walls to comply, but instead would have to build with an eye to the sun's path through the sky each day and over the year. Without directly telling designers how they should comply, tight budget figures would provide an incentive to think solar. Unfortunately, the energy budget levels picked by the Department at this stage of the rulemaking are far too lenient to encourage any such re-thinking by America's builders and designers.

All this is not to say that DOE has muffed every opportunity to encourage solar energy use in BEPS. Energy supplied by the sun is considered to be "free" and it does not count against the design budget of the facility as a whole. Solar hot water heating is encouraged particularly by this energy accounting device. Another way to encourage the use of solar energy might be to announce in advance that the Department will periodically update the Standards, tightening the budget levels. Announced in advance, technology (both design and hardware) would be forced to react, saving increasingly greater amounts of energy. BEPS should be a continuing pressure to bring designers and builders closer to the ideal of a cost-effective building.

Increase Educational Efforts:

Although it is not strictly speaking a matter of BEPS standard-setting, one final point needs to be emphasized. Unless designers are aware of new solar design techniques and ways to apply them simply in conventional buildings, improvements that incorporate solar energy will be slowed down. DOE must take the lead in educating the nation in how to use solar energy. The BEPS program itself also will require re-education of a segment of America's building industry: these efforts ought to be combined. The solar educational effort ought not be isolated from other strategies showing how to save energy in cost-effective ways. Every effort should be made to provide designs, manuals of acceptable practice, pictures, and hands-on demonstrations of solar energy working in real buildings. Since these are some of the same teaching techniques that the Department must use in implementing BEPS, the efforts are parallel and complementary.

* * *

Solar energy has been around a long, long time. Modern studies by Olgyay, Knowles, and other scholars demonstrates that the ancient Indians of the American Southwest understood how to use it. Observation demonstrates that our grandfathers knew how to design for it. We need to relearn, and BEPS ought to help us relearn.

April 9, 1980

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THE CLIMATE OF BEPS

Each of us has strong intuitive ideas about the ways that buildings use energy. One of the most commonly held intuitive ideas is that the amount of energy used depends almost solely on the outdoor climate. While it is true that a building in Phoenix will use a different amount of energy compared to a building in Bangor, focussing exclusively on climate to explain this difference is somewhat misleading. Variations in design and the care used in construction can sometimes overwhelm the differences that climate alone will make. The failure to take the subtle relationship between climate and other powerful factors into account limits the value of DOE's analysis of the relationship between climate and energy use.

DOE used a three-step process to incorporate climatic differences into its BEPS regulations. First, DOE standardized its sample of buildings to eliminate some of the differences attributable to design techniques. Second, it calculated the relationship between these standardized buildings and climate. Finally, it created regulations that were equally stringent for all building owners, independent of the location of the building. If buildings use less energy in Phoenix than in Bangor, BEPS should reflect this difference by setting a more stringent energy budget for Phoenix, while letting Bangor use more BTUs per square foot per year.

Most of DOE's analysis of the effects of climate can be found in the Technical Support Document Number 10, "Climate Classification Analysis." Based on an examination of this TSD #10, the Department needs to improve each of these three steps. This BEPS Gram analyzes this issue.

Standardize the Buiding Sample:

Standardizing the building sample is done in two independent steps: the actual buildings analyzed are standardized and the climate zones considered are standardized.

DOE chose two methods to standardize the buildings used in its analysis. The first method was used for single-family residential buildings only. Here, DOE selected four standard buildings: one each for single story, two-story detached, two-story attached, and split-level. Each of these four buildings was analyzed in each of ten different cities and the design energy requirements were then calculated using the computer program DOE-2. The results of the computation show that for each city, the requirements of single-story and multiple-story residences are very similar and that the only difference in design energy requirements is between detached and attached homes.

For multi-family residences and all non-residential buildings, DOE used a different method of standardization. While the single family homes were analyzed using prototypes that were independent of their location, for commercial buildings, DOE used the AIA/RC sample of 1,661 buildings located throughout the country. The sample, consisting of actually designed buildings, of course has a large variety of individual designs and is therefore much too small to make any accurate analysis. Indeed, one of the Department's contractors admitted that the designs "reflect a large variance, (thus) any statistical estimates computed from them reflect very large error limits." Nevertheless, the designs were grouped by location and design energy requirements were calculated. Since the sample contained only blueprints (not actual buildings), these calculations were done by a computer program called AXCESS. The use of individual designs in the AIA/RC sample does not standardize the buildings as well as using the four prototype residences. DOE should use prototypes -- with all their problems -- for the commerical analysis. Only in this way can the variations other than climate be factored out.

The Department chose to standardize the climate zones used for all buildings by looking at Standard Metropolitan Statistical Areas (SMSAs). An SMSA is a collection of suburban counties and the large city in the center. BEPS has added to the list of SMSAs other, smaller cities in order to develop a total of 78 different climate zones. If a builder is beyond a certain radius from any of these zones, there is a complex procedure developed to determine which zone is to be used by the builder.

Using the SMSA-approach may be defensible, but only if it is used throughout the analysis. Unfortunately, it was not. The residential analysis was done before the SMSAs were chosen as the standard zones. Consistency is a problem for the non-residential buildings as well. Originally, in the Advance Notice of Proposed Rulemaking issued in 1978, these buildings were analyzed in seven climate zones. Thus, most of the analytical work -- including picking which buildings to include in the sample -- was done with this seven climate zone pattern in mind. If SMSAs are to be used for the final rulemaking -- and there is much to commend this choice -- DOE should clarify how builders of structures outside the 78 should areas pick a SMSA simply. Moreover, DOE should analyze the effect of its inconsistencies on the final rule.

Determine Relationship Between Climate and Energy Use:

Once the design energy requirements of all buildings have been calculated, DOE next determined how climate affects those energy requirements. Of course, climate is not a simple concept, but is made up of temperature, humidity, wind, rainfall, insolation, and altitutde, among other things. The Department states that only temperature is important for building energy use. This surprising conclusion again may be right, but it would be comforting to have some discussion concerning the basis of this conclusion.

Given this limited definition of climate, how is temperature to be measured? The most common method is to calculate "degree-days" for heating and for cooling. A heating degree-day is the number of degrees the average daily outside temperature is below an arbitrarily selected base temperature; over the course of the year, these are summed to give annual heating degree days. Customarily, degree-day figures include the base temperature in parentheses; 65°F is a common base. Cooling degree days are basically the same concept, using number of degrees over an arbitrarily picked base point.

Despite the common usage of degree days in all kinds of work, they are not without their analytic difficulties. The base temperature selected can strongly affect the relevance of the degree day figure for estimating how warm or how cold the climate is perceived to be. If one chose a base of 32°F, many places that are commonly thought to be frigid would have relatively few annual degree days; thus this low base would not be very helpful in determining heating needs. The common base, 65°F, is near to a temperature at which most people feel more or less comfortable; even so, this human comfort range is highly variable. A second problem with degree days is that they measure only the *average* outdoor temperature. Since it would be impossible to monitor temperature continuously at all locations, several scattered readings must be made during the day, then averaged. Both the choice of a base temperatures and the averaging of outdoor temperature have the same kind of problem: they try to accomodate a range of real-world facts in a single number. The errors that such approximation can cause can be compounded if the approximations are not representative. DOE's calculations, for example, chose a 50°F degree base for cooling and a 60°F base for heating. These figures were chosen after statistical analysis of the commerical building sample only showed the "best" relationship between design energy requirements and degree days. However, as mentioned earlier, many of the observations in the AIA/RC commercial building sample are based on behavior of individual, non-standard designs. Indeed, there is so much variation in the sample that few firm conclusions should be drawn about degree day bases from this information.

DOE should have chosen a more reasonable base temperature that reflects the comfort range of building occupants. The present bases used in the Notice of Proposed Rule Making do not give any information on comfort. In addition, DOE should not have simply assumed that comfort levels are equivalent in residential and commercial structures. Commercial buildings require more air-conditioning to compensate for their scale and their uses.

For averaging daily temperatures as well, DOE should have used a more precise procedure. For part of its analysis, this temperature was computed as follows: first, the daily average temperature was calculated by taking the difference between the highest and lowest temperatures and dividing by two. Second, these daily averages were averaged together for each month. Finally, a day was chosen from each month that had an average temperature most closely approximating the monthly average. There are so many averages used in this process that is hard to understand how DOE's "average daily temperature" can explain real world events.

DOE should have used a wide representative set of indicators of the range of daily temperatures. The Department could have strengthened its analysis, for example, by looking at the procedure adopted by the Minnesota Energy Agency in a study (Analysis of Energy Use in Minnesota State-Owned Facilities) looking at quite different questions. The Agency looked at 42 buildings and calculated energy use based on many variables. Initially, the Agency started by using six variables in its analysis; subsequently, it added other combinations of variables until it found the best explanation for the energy consumption it was trying to explain. In a similar fashion, using climate variables rather than building variables, DOE should have tried using different combinations of climatic factors rather than simply relying on one factor "averaged" beyond recognition.

In an attempt to validate the initial heating and cooling degree day analysis, the Department had a consultant map regional trends of various climatic factors. The maps are inconclusive and at one point the consultant forthrightly admits that "the algorithms (producing the maps) were not sensitive enough to subtle changes in the data and, therefore, almost any data, if mapped, would show some regional trends" (TSD #10, page B-47). The Department should not attempt to include this work to support BEPS. What is needed is a fresh start on commercial buildings, using prototype structures and a consistent and rational study design to explore the relationship between climate and energy use. In advance, there is no way to predict the outcome of this study or the effect it will finally have on the BEPS energy budget figures, but DOE needs to redo its homework in order to strengthen the analytic basis of the standards.

Make Equally Stringent Regulations:

BEPS should be equally stringent for all buildings, regardless of location. However, no work was done on this matter other than stating that it was an objective of the analysis. Had the Department used prototype buildings throughout its analysis, checking stringency would be an easy matter. Without prototypes, there is no way of knowing how stringent the regulations are for different locations.

* * *

Climate is a crucial influence on how buildings use energy. A recent book on the subject of buildings notes that "post-World War II construction and design has tended more and more to reflect a self-defeating argument against climate, rather than a compromise with it. Mechanical space-conditioning equipment (particularly air conditioning), high-speed elevators, and plumbing innovations that divorce water and sewage service from considerations of building height have all contributed to our ability to shut climate out." That era may be coming to an end, faced with the cold reality of high energy costs. We need and deserve a rigorous analysis of climate and how it can work for us in building design. DOE has started that analysis, but there is still much to be done.

April 11, 1980

Beps Gram

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EDITORIALLY SPEAKING . . . .

The Washington Post

Bettering BEPS

ONE THIRD of the country's energy is used in its buildings, and much of it is now being wasted. Therefore the development of the first set of standards defining minimally acceptable levels of energy efficiency in new buildings is an event of importance.

The new standards are called BEPS—Building Energy Performance Standards—and they are, of course, already in trouble. The trouble has several causes. The Department of Energy has been timid in formulating the standards; the building trades and utilities fear that the standards will be bad for business; and Congress, in an unusual display of overenthusiasm for conservation, has defined a set of penalties for noncompliance so harsh that they could never be applied—thereby leaving compliance totally voluntary.

The purpose of BEPS is to introduce changes in building design and technology faster than market forces alone could bring them. Any large industry has a built-in resistance to change, but economic realities generally change gradually so that industry stays in step. But when—as with current energy prices—economic changes are abrupt and very large, industries can fall way behind. Detroit, for example, has watched high-mileage imports nearly double their share of the car market since 1974.

Instead of defining the BEPS so that they will force a faster pace of technological change, DOE has based the standards on technologies that were in use in the mid-1970s, long before the trend in energy prices had become visible. Rather than taking full advantage of what can be done in the future, the proposed standards consider only the kinds of energy-efficient design that were in common use in the past. And in many cases, DOE ignored its own analyses, which showed that additional changes would be economically beneficial not only to the nation as a whole, but to the individual building owner as well.

Builders—already understandably worried about the impact on their industry of 20 percent interest rates—oppose any change that adds additional cost, no matter how small, to the purchase price of their products. The officials who have traditionally set building codes at the state and local level oppose any action by the federal government, even though putting BEPS into effect will be the job of the states. And, finally, utilities—faced with growth in energy demand far below what they had predicted and with expensive power-plant investments that must be amortized—fear that energy conservation will cost them more money. Funds are reportedly already being collected for a massive court assault on BEPS, even though it will be many months before the standards are issued.

During the nationwide hearings now being held on BEPS, DOE is hearing almost entirely from the building trades, and it is almost all criticism. DOE needs to hear more support from everybody else and to be encouraged to improve the proposed standards—at least to the level supported by its own economic analyses. Congress, meanwhile, needs to look again at its sanctions and to define a realistic set that could actually be used.

Change in the old ways of doing things is always uncomfortable—or worse—for someone. But in this case, the problems pale beside the benefits to consumers and to the country that will come from new generations of energy-efficient buildings.

April 16, 1980

Beps Gram

The Conservation Foundation
1717 Massachusetts Avenue, N.W., Washington, D.C. 20036

DISCOUNTING BEPS

One of the more misunderstood concepts in economics is the "time value of money." Simply stated, a dollar spent today does not have the same value as a dollar spent a year from now. If you save your dollar, instead of spending it, you can get interest from a savings account, killings on the stock market, or even a lucky day at the race track. Put differently, holding on to your dollar provides you with several opportunities to spend or invest it in the future, quite possibly in ways that will bring you more satisfaction than if you spent it now. The amount by which the future value exceeds the present is called your "discount rate." If you can put your money in a 18% money market fund, your dollar would be worth $1.18 a year from now; this 18% is the discount rate, and you simply multiply by the investment of $1.00 to obtain the future value.

The discount rate is also used to compare investments that you might make at different times in the future. Suppose you want to compare the value of your dollar today with investing $1.30 ten years from now or $2.00 thirty years from now. You want to know which of these three alternatives will give you the largest present value. In this example, we use the discount rate to bring future investments back to the present time. (This is the reverse of the example in the first paragraph, which started at the present and looked forward into the future.) In order to start with the future and work back to the present, you must divide your investment by the discount rate. If we assume your discount rate is 10%, the present values of each investment are $1.00, $0.58, and $0.11 respectively. Thus the first alternative -- investing $1.00 today -- gives the highest present value. It is important to remember which direction you are looking at when you use a discount rate. Moreover, choosing the discount rate is not a science, but rather reflects how individuals (or groups of individuals) really value their investments in the future. The discount rate should be chosen at the time the investment choice is actually made: hindsight a year or so later may change our opinion about proper discount rates to pick in making future choices but does not affect the choice we have already made.

A final preliminary point needs to be made about discounting. Inflation alters our behavior significantly, since inflation changes the value of future money compared to present money. If we have a personal discount rate of 8% and we invest a dollar in a savings account, a year later we expact $1.08. However, inflation makes this $1.08 worth less in purchasing power. If we assume the rate of inflation is 5%, then the real (that is, including inflation) rate is only 3% and our $1.08 is worth only $1.03. Economists use the terms real and current to distinguish whether the effects of inflation have been taken into account. Real rates incorporate inflation and compare "constant dollars," which are dollars whose value changes only because of their time value and not because of inflation or recession in the economy. Current rates do not incorporate inflation and use "current dollars," which are dollars whose value is determined by current economic conditions, including inflation. In this BEPS Gram, we will use only real rates and real dollars, thus ignoring the effects of inflation.

How does this "primer" on elementary economics have anything to do with BEPS and energy conservation? BEPS uses discount rates in two important places: (1) to determine costs and benefits faced by each building owner making a decision whether to install more energy conserving technology at the time the building is built or to pay higher fuel bills later; and (2) to determine costs and benefits faced by all individuals in the nation collectively. The two calculations are very different. Each building owner only considers the costs and benefits he or she faces during the period of ownership, using the price of energy actually charged by the utility. However the national perspective includes these costs and benefits but also includes the costs and benefits for all buildings we occupy, the costs and benefits facing industries involved in supplying materials and labor, and the costs of supplying the new energy that is being consumed.

Let us consider the use of discounting for only the individual owner. For single family homeowners, BEPS calculates a strategy to minimize the life cycle cost faced by each individual. The discount rate used in this calculation in order to bring all future costs back to a single present value is a 3% real rate. (For commercial and multifamily buildings, discount rate is not used, since the standards are not based on life cycle costs, but rather on a sample of actual buildings designed then re-designed. In prior BEPS Grams, we have already criticized this methodology.)

Looking at the energy standards from the viewpoint of only the individual homeowner tends to understate the savings from conservation by a large amount. The energy savings accrue to the nation as a whole, and it is fair to ask all of us to make investments that pay off for the nation, not simply for us. Put differently, if we all make investments that are slightly larger than we might if only our own interests were involved, we will all be better off. This process works out in other areas of life as well. A single taxpayers' contribution to good public education may be of no immediate benefit to him or her, yet the community as a whole strongly benefits from a good education system and that community benefit makes the taxpayer better off as well.

For BEPS, we need to look at nationwide costs on a level that are less than overall benefits. These costs and benefits are determined by how strong the energy standards are. With a strict BEPS, a large amount of energy will be saved, but the costs of construction may increase. This is where discounting comes in. In order to determine how strict to set the standards, we must discount the costs of all new construction and discount the price of energy saved over the lifetime of each structure and during all the years we are interested in studying. The analysis that underlies BEPS looks at all buildings started between 1980 and 1990 and calculates costs and benefits from 1980 to 2020.

The national perspective requires that we make assumptions; unfortunately many of these assumptions were made in a way that makes conservation difficult and more expensive than it should be. For example, oil is priced at natural gas prices, which "understates the benefits of conservation since oil is more expensive than natural gas." Operating and maintenance costs of the original and redesigned commercial buildings are assumed to be the same. And fuel prices use average costs rather than marginal costs; these are matters we have discussed in prior BEPS Grams.

One assumption that is often thought to be critical is the discount rate used for the national calculations. Yet surprisingly, because of the way we actually purchase energy for use in a home, the discount rate means that there is relatively little. Energy is purchased in small, relatively uniform amounts over a very long time. Shifting from a 3% discount rate to a 10% rate (as is done in Technical Support Document #3) shows suprisingly little sensitivity to the discount rate chosen. Put differently, discount rates have much less effect than we might have supposed on the final level of the standards.

Using discount rates is a powerful method to compare present and future costs and savings. Discounting is also a field that can overwhelm and confuse the layperson. If, as DOE's work tends to show, the choice of the discount rate does not make much difference, DOE should not hide this conclusion but should clearly state the assumptions that led to the result. Many people have argued strongly for choosing one rate or another. Instead of pursuing this argument further, we suggest that commentors should choose more attractive targets. The assumptions concerning possible conservation measures to use, the future prices of energy, the first costs of efficient construction -- all of these are far more important areas to BEPS than the choice of one particular discount rate.

April 18, 1980

Senator JOHNSTON. Mr. Napolitano.

STATEMENT OF FRED NAPOLITANO, VICE PRESIDENT, NATIONAL ASSOCIATION OF HOME BUILDERS, ACCOMPANIED BY BOB BANNISTER, SENIOR STAFF VICE PRESIDENT FOR GOVERNMENTAL AFFAIRS; RALPH JOHNSON, PRESIDENT, NAHB RESEARCH FOUNDATION; AND JOSEPH A. NEYREY, CHAIRMAN OF THE LOUISIANA HOME BUILDERS ASSOCIATION'S ENERGY COMMITTEE

Mr. NAPOLITANO. First of all, we have submitted a full statement which we would like to include in the record. I will attempt to summarize, sir, but we do have several pages of my summary, if you will permit me, because we did have a lengthy statement.

Senator BUMPERS. Would you pull the microphone closer?

Mr. NAPOLITANO. Mr. Chairman and members of the subcommittee, my name is Fred Napolitano. I am a homebuilder from Virginia Beach, Va. I am testifying today on behalf of the more than 24,000 members of the National Association of Home Builders who are known as NAHB. We employ over 3 million workers, and we are a trade association. I am the vice president and secretary representing them here today.

I am accompanied here by Bob Bannister, senior staff vice president for governmental affairs, and Mr. Ralph Johnson, president of the NAHB Research Foundation.

Also present today is Mr. Joseph A. Neyrey, chairman of the Louisiana Home Builders' Energy Committee.

Senator JOHNSTON. Why isn't he doing the talking?

Mr. NAPOLITANO. I thought we would save him for later, sir.

Senator BUMPERS. He just happened to be along, is that the case?

Mr. NAPOLITANO. He happened to be in the building this morning and we asked him to come along with us. If you believe that, we'll tell you another one.

First of all, I think our industry, sir, has been one of the leading industries that has been concerned about energy. I think we have taken great strides in energy saving in this area.

There have been some comments made today about the lack of insulation in homes and attics and things of that nature, and about the inefficiency in housing. I venture to say those figures are unfounded, and that if you look especially since 1976, you look at the figures from that time on, you will find a tremendous improvement. If you go back 20 and 25 years, you will find these conditions that some of these people claim exist.

In 1977 the National Association of Home Builders on their own published a digest; "NAHB Thermal Performance Guidelines for One and Two Family Homes," that our members have been using throughout the Nation. I submit this, sir, for inclusion within the testimony as well.[1]

We have spent considerable effort in analyzing proposed statements, and the 2,500 pages of technical support documents that followed the notice of proposed rulemaking. Unlike DOE, our analysis included actual computer runs of real housing designs in cities all over the country.

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[1] See Appendix II.

In addition to the research and analysis performed by NAHB, we met with numerous other groups that will be affected by BEPS. NAHB also participated in the BEPS workshop sponsored by the National Institute of Buildings Science known as NIBS which as you know is the organization created by the Congress to analyze such regulations.

We concur with the recommendations submitted by the NIBS to DOE that DOE should defer issuance of the proposed standards until the technical structural issues have been resolved, and the questions concerning implementation have been answered.

We believe that the Congress responded appropriately in 1976 to the energy situation facing the Nation by authorizing the development of energy performance standards to new buildings. We support the concept of performance standards and the goal of that legislation that aimed at reducing our Nation's dependence on foreign oil and on rapidly depleting supplies of domestic oil and gas.

However, the standards as proposed by DOE will not work. They will not save the quantities of energy mentioned in testimony before the Congress in 1975 and 1976. The proposed rules will not encourage more use of solar energy and other renewable resources.

The proposed rules will in actuality encourage builders and designers to choose oil and gas heat in many types of new buildings rather than electricity. The proposed rule will potentially increase rather than decrease the peak load of electric utilities through the encouragement of heat pumps which automatically include air-conditioning capacity.

Senator METZENBAUM. May I interrupt? That point you make is very significant. Would you just spell it out and back it up a bit? In other words, that the BEPS regulations will encourage more use of oil and natural gas?

Mr. NAPOLITANO. According to the standards as I understand that, if we use the standards as they are proposed, that where there is electricity we may have to be forced to use the other sources at that point, which means we would have to go to a heat pump. A heat pump automatically has air-conditioning capacity along with it, so in essence you are forcing air-conditioning in areas normally where you wouldn't have it.

There are many people in this country that build homes without air-conditioning.

Senator METZENBAUM. That wasn't the question I asked. I was asking, you had made an assertion that the BEPS standards would require more use of oil and natural gas, and what I am saying is, in what way do they do that? I heard the previous witness address himself to this point, but I am not certain what the homebuilders are saying on this score.

Mr. NAPOLITANO. That is, the weighting factors will discourage the use of electricity within certain areas.

Senator METZENBAUM. The same point that Mr. Levine says is positive you say is a negative?

Mr. NAPOLITANO. Yes, sir.

Mr. BANNISTER. It is easier to meet the standard of oil and gas than it is with electricity. It is just as simple as that. You encourage the use of oil and gas.

Senator BUMPERS. That is the point Senator Metzenbaum was making earlier.

Mr. NAPOLITANO. The DOE has attempted to develop a program with laudable goals using an effective set of procedures which is based on a proficient data base with no details on how the program will be implemented.

Now, Mr. Chairman, let me point out some of the specific problems in the proposed rules. DOE spent a great deal of effort in developing an intricate and complex computer program for builders and designers to determine compliance with BEPS. Although DOE has indicated that a simpler method will be issued, our comments can only be limited to what DOE has actually published.

The compliance method labeled "standard evaluation technique" has proven to be incredibly complicated and precluded responsible analysis of BEPS by many individuals.

Senator JOHNSTON. Precluded what?

Mr. NAPOLITANO. The responsible analysis of BEPS by many individuals; sir, if I may add at this time, I believe many of you know that the housing industry is one of the largest industries in this Nation. I think you all know that we are not similar to your automobile manufacturers or steel manufacturers where you have three or four large companies.

Eighty-five percent of our members are small homebuilders building probably less than 10 houses a year with very few employees, and when you get into complicated situations as the BEPS standards would be, there is no way that they can understand it. There is very little way they can comply with it without expert advice on it and having it spelled out at tremendous cost to them.

Senator JOHNSTON. Is it possible to have a set of standards that are meaningful, that save a lot of energy, that are simple in your judgment?

Mr. NAPOLITANO. Yes; we are in favor of anything that will save energy as long as it is simplified and we can understand it.

I heard an earlier statement about the FHA standards. Yes, we live with that. That's fine. We can understand it, but this is so complicated, and all we are asking at this point, if I may even summarize this statement that I have here, is that it be delayed so that it can be analyzed and can be put in proper form, can be understood by those that will implement it in the field, and tested to see if it works.

We find that according to what they have today it will not work. It varies from area to area, using the same standards at different cities in the country, and when you apply them to these cities, they just don't work. Fort Worth and Dallas are two examples. They use the same standards in both cities, and you have to use one type of standard in one and a different standard in the other city. They have the same climate conditions and everything else.

Now again I am going to summarize some of these things. Our builders are building the most economic homes that they can possibly build in today's market, and they are as efficient as we can possibly get them. Now there is room for improvement, but you take a situation here where DOE has said back in 1976 that you are going to save 12½ million barrels of oil per day, and now they are saying all we are going to save is 216,000 barrels of oil per day or about 1 percent is all we are talking about from 1976 until now. That is a tremendous difference.

Senator JOHNSTON. We are not worried about that. We want to have a program that works. Tell us why it won't work. What can we do to get it in place as fast as possible?

Mr. NAPOLITANO. We are suggesting that we delay it, go back, have BEPS work with us and others that are interested in this to get a program that is understood by all, and then let's test it. Put it out in the field in various areas and test it for a period of time and see if it actually works.

Senator JOHNSTON. What would be wrong with as one of the important techniques of requiring a warranty much as an FHA warranty saying that you have met whatever these standards are? You warrant that to a homeowner. What is wrong with that?

Mr. NAPOLITANO. I'm sorry, sir?

Senator JOHNSTON. What would be wrong with requiring as one or maybe the exclusive method of enforcement to begin with a warranty that you have met the standards from the homebuilder?

Mr. NAPOLITANO. We would not object to that if we can meet the standards. What we are saying is that under these conditions we cannot meet the standards. If we can get a set of standards that we can live with, yes, we would be happy to warrant that as we do anything else in the house.

Senator JOHNSTON. Why can't you live with these? You said they are too complicated.

Mr. NAPOLITANO. We get into the more technical aspects, so let me have Mr. Johnson answer some of those questions.

Mr. JOHNSON. There are a lot of reasons, Senator. First, there are highly inequitable. They are so complex and costly it is virtually impossible the way they are available to determine whether or not your home or building meets the standard.

We fortunately had a lot of capability in the computer and we were able to get an extra terminal to access the main frame. We were able to get a lot of answers, detailed answers out of Dr. Levine and others who had defined this program, and we ran 300 or more runs of actual houses in cities around the country.

The minimum cost to model one home by an expert is about $500. If you orient that 1 degree or 2 different to the Sun, you have to run it again, and then you have to add the cost of the lease in borrowing the computer time or running the computer time.

Most engineering firms, most architectural firms, most utilities evidently, because builders have tried to get answers from their utility companies, and most manufacturers, and I am talking about manufacturers expert in the energy area, up to date have been unable to make these runs and determine whether or not the home meets it. It is a counterproductive sort of thing. It may cost $700. There is an engineering firm in New York that is quoting $900 to $1,500 to Ryan Homes per house as the cost of making the determination, and Ryan builds thousands of homes a year.

Senator JOHNSTON. Suppose we got DOE to develop standards like the ASHRAE, American Society of Heating, Refrigeration, and Air-Conditioning Engineers? We required them to come up with those kind of standards that are equivalent to BEPS in lieu of these other kinds—would that satisfy you?

Mr. JOHNSON. I think yes, to a degree. I think that DOE has in their intended program the development, as Dr. Savitz said this morning, of a local manual of acceptable practice.

One of the other problems that it is difficult to live with is that national average costs and national average kind of climates have been used. Our current data is there are 993 digit ZIP Code zones in this country. Every single utility rate for gas, oil, and electricity in every single city of this country is different. The rate of price increase likely to occur for each of these fuels is different.

Senator JOHNSTON. I think we understand that issue.

Senator METZENBAUM. What kind of a dialog has occurred between the NAHB and DOE on this subject?

Mr. JOHNSON. Quite a lot. I think we have cordial relations. DOE has talked to us at length. We have worked in detail with them about much of this, and I think they have been very cooperative.

It is my personal view that they have been forced into a time situation and possibly a budget limitation situation which made it virtually impossible to deliver an administratively workable program in the time allotted, and I think they just need more time to make it local, to get many of these inequities out.

For example, it is far worse and more difficult for a smaller home to meet this standard than a larger one. Therefore, the impact on the smaller and lower income buyer is considerably greater than on the larger home. The per square foot is a problem.

Senator METZENBAUM. How long has this discussion been going on between you and DOE or its predecessor agencies?

Senator BUMPERS. They have been working on it 5 years, haven't they?

Mr. JOHNSON. Well, we developed what they call the voluntary thermal performance guidelines about 4 years ago. We have tried to work with DOE and the Department of Housing and Urban Development over the years on this.

As a matter of fact, our research foundation had some input into the HUD work. I think much of it was ignored frankly, but that is their choice. We have had good technical discussions with the DOE people, and I think that they have been forced into a time situation which has made it impossible to deliver an equitable set of standards that take into account all the local conditions.

Senator METZENBAUM. Mr. Johnson, what I don't understand, you say they are forced into a time situation and you talk about budgetary constraints. Frankly, a lot of time has expired. Certainly the Department of Energy has not had any budgetary constraints. I guess these have been worked out by HUD or the DOE who has worked out the actual BEPS formula.

Mr. JOHNSON. I think it has actually been DOE that has worked out the ones that have been enlarged.

Senator METZENBAUM. We in Congress are put in a rather difficult position. I think that we support the concept as expressed by the gentleman over here at the other end of the table that we think that there ought to be building standards that will conserve energy.

Mr. JOHNSON. So do we.

Senator METZENBAUM. And you do; you say more time. There is a sense of urgency about this entire matter, and I am not quite clear—it is easy to vote yes or no, but I am not so certain that voting yes or no, that we have achieved anything.

What I would like to do is figure out some way that out of this committee hearing or some subsequent hearings or meetings that we can make some headway on this problem rather than you being on one side and DOE on the other, the Wildlife Federation and their constituency on a third.

I think that the real objective is to try to move the building industry not merely on a voluntary basis, but in accordance with the provisions of the law to achieve the objective that has been set forth by the Congress and is attempting to be implemented by DOE.

Mr. **Johnson**. There have been some things said this morning that would give the impression the homebuilding industry has been sitting on its hands and building I think one gentleman referred to it as cardboard houses.

That is just untrue. We have documented data on more than 100,000 homes a year, detailed housing characteristics, on what has been happening, and there has been a substantial voluntary effort by the building industry responding to the energy problem, the rising prices. Mr. Neyrey from Louisiana can tell you what he has done personally in terms of the kind of houses he has been building in response to this problem.

Senator **Johnston**. Many builders have been building very fine houses, but I don't think voluntary is going to be good enough for this committee. I think we crossed that bridge. I think we want mandatory standards, but we want workable standards as soon as we can get them.

Does NAHB support transfer of implementation to the budget of DOE?

Mr. **Napolitano**. No, sir.

Senator **Johnston**. You do not?

Mr. **Napolitano**. No.

Senator **Johnston**. How else are you going to get coordinated implementation of the rule?

Mr. **Bannister**. Mr. Chairman, we testified on this somewhat earlier, and it is our belief that the Department of Housing and Urban Development that has dealt with the housing issue and is in fact in the business to deal with housing has the logistics and the ability to implement a standard better than the Department of Energy.

They do not have the field structure of the HUD area offices, and they do not understand the homebuilding industry as the Department of Housing and Urban Development does as is evidenced by the BEPS standards.

Senator **Domenici**. Mr. Chairman, could I ask a question? DOE has already told the committee they don't think they are ready to go. You are telling us that you support conservation and national standards but that what we have to this point won't work.

DOE recommends that they republish in February and that 1 year from this August is the date for finalizing this.

Now based upon what you know to be the shortcomings of this approach, do you have a position on whether or not that is an adequate timeframe to get this simplified and worked out?

It seems obvious we either have to proceed to abandon the whole thing—which I'm sure we are not going to do—or go ahead and insist that the problems get worked out by a certain time and we get on with it.

Mr. **Bannister**. Senator Domenici, I think the approach that is being taken in both the Senate and House Banking Committees that have reported housing legislation asked for for a delay in the implementation of the building energy performance standards.

During that period of time, it would be our hope that a pilot program would be undertaken to actually demonstrate the impact of the building energy performance standards before they are implemented that would be consistent with the policies and workable in the marketplace.

I think if you have a delay that has been called for by the Housing Subcommittees and Banking Committees who called for this 2-year delay, it is consistent with the problems with the standards and working it out on a time line that makes sense.

Senator **Domenici**. What do you suggest in the meantime to maximize efficiency?

Mr. **Bannister**. I would think if there is a date certain set which has been spelled out in both the Banking Committee bills, then that is the date that has been established. In working toward that deadline there would be a pilot program because unless there is a pilot program we will be back here 2 years from now with the same problem.

It has not been demonstrated in the field to be workable, effective, or in fact to save energy that DOE has stated as its goal to save under the BEPS standards.

Mr. **Dean**. I just wanted to make sure the Senators were aware that the legislation that is coming out of the House and Senate Banking Committees calls for a 2-year delay. DOE this morning only requested a 1-year delay, so that we, of course, feel that the standards are in sufficiently sound condition to be issued immediately and any delay that occurs would best occur in the implementation phase, in the enforcement phase rather than in the promulgation phase.

Senator **Johnston**. Let me ask you both a question. Suppose that we immediately put the standards into effect and required that the only sanction would be that each builder would furnish to the prospective buyer a statement as to whether they met the standards or not and some statement that DOE recommends these standards—this house does not meet the standards and you have to put it in the following respects.

If you said it did meet the standards, it will constitute a warranty, enforceable then by the buyer. What would be wrong with that as an immediate problem area?

Mr. **Bannister**. One of the difficult problems is knowing whether or not you are meeting the standards, and we are not at the point in time now where the homebuilder can ascertain through a computer program on whether or not he is going to be able to make that standard, so it would be very difficult to predict to the home buyer.

Senator **Johnston**. We are talking this morning about two different kinds of standards. The first is the performance standards, and the other is this whether you have got 2 inches of insulation in the ceiling. They haven't come up with the second kind.

Mr. **Bannister**. This is one of the most difficult situations that we are facing with the BEPS standard, and that is we are going from a standard that has been a prescriptive standard that has been used in this country since the houses have been built to a performance standard, a totally new concept, and switching overnight, getting from point A to point B is a very difficult task for the second largest industry in this country, and that is the question—how do you get from point A to point B?

We think with a 2-year timeframe to look at that, with a pilot program test, is one of the answers that could be very helpful in getting it.

Senator **Johnston**. Frankly, I know a lot of builders. Some are very sophisticated and some just go out and build a house and they can't go into all this computer program.

Until we have a prescriptive standard that tells you what to do with your insulation and that sort of thing, until we have that, how can we expect them to live up to the performance standard?

Mr. **Dean**. There has been a lot of talk about the need this morning for increased expertise in dealing with computers and what a terrible burden it will be on individual builders.

The fact of the matter is that DOE has committed itself to develop these cookbook approaches, the approaches that all of the builders and designers in this country are familiar with.

In our view, the translation of the existing standards into the cookbooks will take only a matter of several months and not 2 years.

Senator **Johnston**. You say you want them to be effective immediately, but you don't mean immediately?

Mr. **Dean**. I mean the standards should be promulgated—in other words, the standards as written on August 14, 1980, they are not effective under the law for 1 year beyond that. Within that 1-year period by the date of August 14, 1981 DOE will have available these cookbooks for designers to use in building.

Senator **Bumpers**. Why didn't they come out with a cookbook approach to begin with?

Mr. **Johnson**. By any means they can't do it in that short a period of time. The basic computer program produces false numbers. For example, you can build a house with almost any kind of insulation protection in Miami and Los Angeles, but you can't hardly build one at all in Seattle or Kansas City. It is just that you get absurd answers.

We have homes we have very carefully instrumented and measured the amount of energy used while people are living in it, and we can tell you that in one that is very well thermally protected, and one that is just well protected, that computer program predicted actual energy use for heating energy for the entire year now 80 percent more than was actually used and 30 percent less, 32 percent less for cooling energy.

It has a number of assumptions in that program, including the weighting factors, which need substantial review and modification if they are to be used at all.

Senator **Bumpers**. Are you saying that the standards can't be met in Kansas City?

Mr. **Johnson**. It can be met, but with absurd levels of thermal protection.

Senator **Bumpers**. With no windows, for example?

Mr. **Johnson**. Triple glazing, 20 inches of insulation in the ceiling, an R-27 wall. I don't know how you build an R-27 wall, and what it does currently is force people to pay like $15 for something that will save $10, and I don't think that our industry wants to be in the position of foisting that upon the people, and I would presume that the Congress doesn't either.

Senator **Bumpers**. Are you saying your organization has done tests in cities like Seattle and Kansas City and you are saying that the standards that they have in their present rules cannot be met without just the kind of gross things you are talking about?

Mr. **Johnson**. We have models of standard kinds of houses on their computer program, and yet we have those kinds of results, yes, sir.

Senator **Bumpers**. Where is the DOE witness?

Senator **Johnston**. Dr. Savitz?

Senator **Bumpers**. How do you respond to that?

Dr. **Savitz**. In most of the cases I think we and NAHB have agreed with numbers that could be met. We have shown that there are existing technologies that are available that can meet the standard now.

Senator **Bumpers**. Are those technologies known to DOE and not to the home builders?

Dr. **Savitz**. I think part of the reason is again having the cookbook available. We consciously made an effort in setting the targets to say use this insulation, 2 by 4's, not 2 by 6's, not using heat exchangers, but really to use what technology was readily available and could be readily used by the builders.

In our testimony in public hearings many builders said they are already building energy efficient homes and those only add costs of $500 to $1,000, less than $1 a square foot, so we feel the present standards can be met with existing technology in all areas of the country, and economically.

Senator **Bumpers**. Do you think the home builders had good input into the development of these regulations?

Dr. **Savitz**. As Mr. Johnson mentioned, we have worked together with them.

Senator **Bumpers**. Why have you not been able to resolve this which seems to be the whole crux of the controversy here? Why have you not been able to resolve this? I am still not following you. You say there is technology available, for example, to meet the very question he raises, that is, that in order to build a house in Miami it is OK but to build one in Seattle and Kansas City is an entirely different matter?

Dr. **Savitz**. We feel there is existing technology, and you can meet the standard in Seattle and in Kansas City, for all the cities with existing technologies.

Senator **Bumpers**. He says it takes an R-28 wall.

Mr. **Johnson**. Twenty-seven.

Senator **Bumpers**. An R-27 wall in Kansas City; how do you build an R-27 wall?

Dr. **Savitz**. We feel you can do it with, by having more in the ceiling and you might have triple glazing, that type of thing.

Senator **Bumpers**. Can you assure this subcommittee then that when your cookbook comes out, that is what it will be, no more than an R-19 wall, for example? They say they don't know how to build one.

Dr. **Savitz**. I am fairly sure with the existing numbers in that present proposed rule we could make it with existing R-19's in the wall—you may have it higher in the ceiling, but again not higher than R-38.

Senator **Bumpers**. Would it require, for example, in some of your rules, according to your own understanding, would it require 20 inches of insulation in some areas of the country?

Dr. **Savitz**. Probably not except maybe in the most northern areas of the country; in the performance standards it makes a tradeoff. If a person wants to put in 20 inches of insulation, he can, and put less inches into the wall. He has that flexibility, but we can come up with a solution that would not require that and still meet the standard.

Mr. **Johnson**. Those are not the answers that we met with the DOE-2 computer program. The house I am talking about in Seattle is 26 by 42. It has R-15 in the ceiling, R-27 wall, triple glazing, R-19 in the floor, and you can't heat it with electricity anyway, and that is very cheap electricity out there, including the heat pump from hydropower.

I don't understand the talk about the economics being involved. That is part of the weighting factors, part of the averaging across the country, part of the difficulty with not getting the local conditions factored into this.

Senator **Bumpers**. That is a very good point because electricity is cheaper in Seattle than natural gas is in Arkansas.

Senator **Johnston**. Would you feel any differently about this when the cookbook comes out?

Mr. **Johnson**. If the cookbook is based on a computer analysis which is correct—for example, earlier today, Senator, you said that you would be in favor of some kind of standard that required insulation in basements. Our understanding of the DOE-2 program is that they ignore heat loss from basements and that is why when you essentially ignore that U value for the floor which is .501 according to the Lawrence Berkeley Laboratory, which is essentially ignoring it, and heat loss through slabs in the summertime seems to be one of the problems, it is considered to be higher we believe than is actually the case, that is why the model gives such false numbers.

The economics are based on a computer program. When the economics of the level of thermal protection predict 80 percent too much energy being used for heat and 32 percent less than what is actually used for cooling, it stands to reason that the economic results have to be in serious question.

Mr. **Strom**. I would like to say a couple words to respond to Mr. Johnson, and I would like to point out some of NAHB's own statistics.

In Louisiana, since we do have a few people from Louisiana here today, between 1977 and 1978 the average R value in new homes in Louisiana decreased from an R value of 11 to an R value of 8.5—NAHB's own numbers.

It seems to me rather odd that we are saying we are building good houses and that the marketplace is taking care of it when on the other hand we have a year going by and less insulation is being put in homes. There have been a lot of numbers tossed about here this morning.

Senator BUMPERS. You are using just new construction?

Mr. STROM. This is new construction—the NAHB Research Foundation.

Mr. JOHNSON. I would like to see those, but I presume he is referring to level of insulation protection in walls which could have been changed because of the switch to more masonry homes versus all frame.

Further than that, there is a blip in the level, in the constantly increasing level of thermal protection for insulation only, not other factors like more efficient heating systems and increases in the level of thermal protection from glazing which is very important because in 1978 you will recall they were rationing insulation and it was extremely difficult to buy insulation.

There were all kinds of problems raised, and then that is the blip that is in there, and it is a very minor blip.

Senator JOHNSTON. Let me say I think this committee through our legislation is committed to mandatory standards as quickly as is feasible.

On the other hand, we want to get some standards that work. We don't want to put the building business out of business by inability to understand complicated regulations. We have got to have cookbooks, cookbooks that work, and I think we would be loathe here to try to prematurely order implemented some standards before we see how you work through the cookbook. If the cookbook comes out and then you have some real criticism of the cookbook, then that is quite a different thing.

Mr. STROM. There are cookbooks available in Florida for the section 9 code. It is a simple worksheet that takes about half an hour. Any builder can fill it out. In fact, most of the builders in Florida really appreciate this kind of approach because it gives them a very obvious demonstration of what the standards are. You fill out the sheet and you have a total number of points at the end of your worksheet. If you are less than 100, you have complied with the standard, and if you are over 100, you can see how much farther over you are, so you know what to cut down on to improve the building.

Senator JOHNSTON. Let me ask you this because we really need to move on to our next panel. I wish both groups would give us in writing whatever assessment you can on first of all this question of warranty, whether there ought to be a warranty and how it ought to be enforced.

It might take a look at FHA, their warranties, and whether that sort of thing is practical here, and you might also give us your thoughts on—it might be in the written statement, I don't think it is—but on some intermediate sort of trial steps and sanctions; in other words, rather than going all the way and putting it in the building code, requiring that it be in the building code, what are some intermediate steps that we can make it have a real trial of these standards during a shakedown period, without putting builders out of business, but easing them into these standards.

Gentlemen, there are so many more questions I would like to ask you, and I know other members of the panel would, but we better move on to our next panel.

Mr. NAPOLITANO. Mr. Chairman, may I make one very brief comment on a related matter? I understand you have put a hold on Senate bill 2719, the Housing Community Development Act of 1980.

Now I understand your concerns about energy and you have legitimate concerns and we want to get that resolved. I am just imploring you to see if we can't get that moving as quickly as possible. There are many provisions in that bill that are necessary to get a depressed housing market moving again for the good of the country.

Senator JOHNSTON. We hope to be able to work that out. That is because of the difference over the Energy Management Partnership Act (EMPA) provision.

Senator BUMPERS. Let me ask you a question. What effect have the falling interest rates in the last month had, if any, on turning the housing industry around in this country?

Mr. NAPOLITANO. Very little at the moment; what is happening now, to give you an illustration, when the interest rates were going up, people would still buy FHA/VA rate of 13 percent. When it hit 14 seems to be a magic number, and everybody stopped buying. Now on the 11½ percent rate on FHA/VA people are not buying. They are tuned to recession. The psychology of it now is don't buy. It was the other way—buy now before it gets any higher, so we have to overcome that again.

Senator BUMPERS. They are waiting until it goes lower?

Mr. NAPOLITANO. That is exactly right. We have to overcome that not only in housing but in automobiles, the whole thing.

Senator BUMPERS. Where do you think it will have to go before the psychology changes?

Mr. NAPOLITANO. I don't think it is a matter of the rate going down. If it was 5 percent, which is impossible, it would be something else again, but within a matter of a few more percentage points I don't think this is the main thing. I think this is the psychology of the country now and Congress and the administration must say hey, we are moving again, let's get out there and do what has to be done to get the country moving again. Until people get confidence back, we are not going to move.

Senator JOHNSTON. Thank you very much.

Mr. NEYREY. I would like to make one comment about the State of Louisiana.

Senator BUMPERS. Take as long as you like.

Mr. NEYREY. If we go with BEPS as it is now, for all practical purposes, we cannot build air-conditioned houses in the State of Louisiana. This is the concensus by the Department of Natural Resources which is headed by an architect by the name of Mr. Smothers, and also the utility companies in Louisiana.

We use five times as much electricity for air-conditioning as we do energy for heat, and we have no choice. For all practical purposes, you only have one type of air-conditioning, and that is electric air-conditioning, and if we have to use the weighting factors as we are right now, we just can't comply or it is almost impossible to comply with the BEPS as it stands now.

Senator JOHNSTON. Dr. Savitz, did you hear that?

Dr. SAVITZ. I heard that, and I am surprised. The assumption was that there was electric air-conditioning in those parts, particularly all the Southern parts of the country when we arrived at our numbers.

We will check into that and provide to you a model solution, including air-conditioning with existing technologies.[1]

Senator JOHNSTON. Seriously, we must have air-conditioned homes in the South or we won't survive.

Senator DOMENICI. Neither will you, Mr. Chairman!

Dr. SAVITZ. Our assumption was air-conditioning in those houses. I will get that for you.

Senator JOHNSTON. That's really important! Thank you very much, gentlemen. I might state that we are going to have another day of hearings on June 17 for all of you who may be leaving now and before the end of this next panel.

It looks like Dr. Cooper with the Consumer Energy Council of America will probably need to testify on June 17. Where is Dr. Cooper? Is that suitable with you?

Dr. COOPER. That's fine.

Senator JOHNSTON. Good.

[The prepared statement of Mr. Napolitano and a subsequent submittal from the NAHB follow:]

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[1] See DOE response to question 11 in appendix I.

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STATEMENT OF

THE NATIONAL ASSOCIATION OF HOME BUILDERS

before the

SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

SUBCOMMITTEE ON ENERGY REGULATION

on

PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

June 5, 1980

Mr. Chairman and Members of the Subcommittee: My name is Fred Napolitano and I am a home builder from Virginia Beach, Virginia. I am testifying today on behalf of the more than 124,000 members of the National Association of Home Builders (NAHB), who employ over 3 million workers. NAHB is a trade association of the home building industry of which I am Vice President and Treasurer. I am accompanied today by Bob Bannister, Senior Staff Vice President for Governmental Affairs and Mr. Ralph Johnson, President of the NAHB Research Foundation. Also present today is Joseph A. Neyrey, Chairman of the Louisiana Home Builders Association's Energy Committee.

Mr. Chairman, I appreciate the opportunity to appear before the

Subcommittee today to present our testimony on the Department of Energy's proposed Building Energy Performance Standards, better known as BEPS. We are proud of the accomplishments of the building industry over the past several years in building more energy efficient homes. I think I can simply state that no industry has made greater strides in saving energy.

I would also like to commend you for calling these hearings on the very important subject of energy conservation standards for new buildings. We view these proposed standards and their implementation as one of the most significant and far reaching federal actions ever undertaken to effect the second largest industry in the United States -- homebuilding.

At the outset, I would like to state that NAHB strongly supports measures to effectively reach the goals of energy conservation. NAHB has been a leader in the energy conservation field for over twenty years. NAHB built its first energy research house in 1956 and published our first insulation manual over a decade ago. Since the Arab oil embargo of 1973, home builders have increased the energy efficiency of new homes by over 34%. This trend is continuing and our data for the last few years will be complete within a few months.

The National Association of Home Builders has spent considerable effort in analyzing the proposed standards and the 2,500 pages of technical support documents that followed the notice of proposed rulemaking. Through our membership, staff, and the NAHB Research Foundation, we have examined the budget numbers, the Standard Evaluation Technique (SET), the economic analysis, implementation studies, and many other aspects of the proposed regulations. In addition to the research and analysis performed by NAHB, we met with numerous other interested parties regarding BEPS. NAHB also participated in the BEPS workshop sponsored by the National Institute of Building Sciences. We concur with the statement submitted by NIBS to DOE on behalf of the building industry, which concludes that DOE should defer issuance of the proposed standards until the technical issues have been resolved.

Before I mention some of the specific problems with the proposed standards, I should point out that NAHB and the industry we represent favor the concept of performance standards for the energy conscious design of new buildings. However, it is the judgment of our association and the building industry that the BEPS as presently proposed are untested, unsubstantiated and uneconomic. The standards as presently proposed will not achieve their intended purpose, of saving scarce supplies of oil. Furthermore, we believe that these proposed standards will not be implementable in their present form. Much more attention needs to be directed to the questions of implementation. Already, since the law authorizing BEPS was written, DOE's estimate of energy savings due to BEPS has decreased from 12.5 million barrels of oil per day by 1990, to less than 216,000 barrel per day by 1990. This is less than 2% of the 1976 estimate. The purpose of Title III of Public Law 94-385 was to achieve the maximum practical improvements in energy efficiency and increases in the use of nondepletable sources of energy in new residential and commercial buildings. This is a laudable goal, but one which will not be achieved by BEPS in its present form.

STANDARD EVALUATION TECHNIQUE (SET)

DOE's use of a standard evaluation technique to determine compliance with the proposed energy standard has proven to be an unnecesarily complicated procedure. NAHB has spent hundreds of hours in computer time analyzing the Standard Evaluation Technique, (SET), and can conclude that it is impractical for residential and commercial construction. The SET is not only beyond the capability of builders and building officials, but also most of the design professionals in this country.

Private analysts in many areas of the country have been attempting to utilize the BEPS computer program, known as DOE-2, for several months to develop sufficient information to prepare comments for the DOE public response program. This has proven to be impossible. Without independent "on the spot" decisions by those using the BEPS computer program to correct errors in the SET, no analysis of proposed designs in housing construction can be made by using the technique offered by DOE. Despite the fact that the SET is incomplete and inaccurate, DOE has offered the SET as the only method for determining compliance with BEPS. In order for the building industry, including building officials who will be responsible for enforcement of the standards, to understand BEPS, a simplified standard evaluation technique is necessary. Such a technique must be useable without professional help not only for residential buildings but also for light commercial buildings.

This Committee should be aware that the complexity of the SET coupled with its general unavailability has prevented most individuals and firms affected by these proposed regulations from offering substantiated comments. In order to evaluate the desirability of solar systems in a design, for example, an additional computer program must be used. This program is even more complex than the DOE-2 computer program, and effectively precludes meaningful analysis of solar designs during the rulemaking proceeding.

A third computer program, must also be used for some analysis, and it confuses the process even more because it is simply unavailable.

We are gravely concerned that many segments of the building community are precluded from participating in an effective and meaningful way in the rulemaking procedure because the SET is so complex and generally unavailable. DOE staff has recently indicated that the principal computer program, (DOE-2) has already been revised, which could render our research and analysis obsolete. We are now prevented from determining what effect the revisions will have on our comments filed with DOE.

The SET is not a design tool and was not originally intended for that purpose. The SET is a costly, complex analytical tool that if corrected to eliminate its technical errors would still not assist in achieving energy conserving buildings. It is in the nation's interest to simplify the method of determining compliance with the standards to the maximum extent possible. This will allow builders and designers to focus on energy conserving designs and simplify the task of educating building officials to ultimately approve permit applications for new buildings.

The SET contains many technical errors which in turn lead to inconsistent results nationwide in energy consumption numbers. BEPS for example, encourages air infiltration in buildings, which simply means BEPS calls for buildings to be less air tight. This obviously will greatly affect the energy loss in buildings. The standards set an arbitrarily high minimum rate of 0.6 air changes per hour, disregarding current building practices. Reducing air loss through construction practices such as the use of higher quality windows (double glazing), doors, storm doors, weatherstripping, caulking of construction joints, sill sealers and other techniques are very important in reducing the energy consumption of a building. Compared with increased amounts of insulation and multi-glazed windows, the reduction of air infiltration is a much more cost effective means of providing added thermal protection. These practices should be encouraged, not discouraged, by BEPS.

The SET also assumes that every home built in the United States will have central air conditioning and therefore mandates the inclusion of energy consumption from air conditioning in the design energy consumption figure. According to the NAHB Research Foundation's annual survey of new home statistics, in 1978 only 68% of new homes built were centrally air conditioned. The inclusion of air conditioning then in the design energy consumption figure penalizes 1/3 of the new home buyers each year. We believe the BEPS therefore would encourage more homes to be built with central air conditioning regardless of climate. This in turn could lead to greater energy use in these homes.

The SET also totally disregards practices by home owners to save energy. Allowances should be given for such things as night time setback thermostats, lower thermostat settings on water heaters, thermal protection of windows such as shutters, moveable insulation, drapes, shades, and any other user device that will save energy. DOE's explanation that the difficulty in assuring the use of these devices prevents their credit in the SET, denies the fact that homeowners are responding to energy costs by taking such logical steps. BEPS, as presently proposed, therefore discourages energy conservation by homeowners.

Limiting the residential analysis in DOE-2 to a single thermal zone in a building is another example of restricting user operated devices. When separate control is provided for various thermal zones in a house, the occupant will be able to use these controls to conserve energy. The inability of the SET to model multi-zone residential heating systems also robs the homebuyers of an economical heating option in areas of minimum or moderate heating requirements. Electric baseboard heating systems individually controlled in each room, are often the cheapest type of heating systems to install, and compare in efficiency for space heating to heat pumps in cooling-dominated climates. BEPS should encourage, not discourage, these types of inexpensive practical heating systems.

BUDGET NUMBERS

The process used by DOE to determine the energy budget numbers has resulted in many inequities and inaccuracies. It is clear from the technical support documents that DOE has not analyzed the effect of the proposed budget numbers on real or prototypical buidings in the majority of the 78 SMSA's for which budget numbers are proposed. Instead, DOE has arrived at the budget numbers for 78 SMSA's through regression analysis, which has proven to be highly inaccurate. The result is budget numbers which will place impossible burdens of compliance on many buildings.

The proposed energy budget numbers have an adverse cost impact on the construction of small family homes. Our analysis clearly shows that the smaller the house gets, the greater the requirements become for energy conservation. In fact, in some areas of the country, it becomes impossible to build smaller houses even using R-50 ceiling insulation, R-27 wall insulation and triple glazed windows. R-50 insulation for example would be approximately 20 inches thick. Smaller houses, which are traditionally houses built for young families, will pay a disproportionate cost under the proposed rules. The BEPS would therefore encourage the building of larger homes.

Our analysis indicates, for example, that in Denver, a 1,092 square foot home with gas heat requries R-38 ceiling insulation, R-13 wall insulation and double glazed windows. In Washington, D.C., the same 1,092 square foot home with gas heat would reqiure R-38 ceiling insulation, R-19 wall insulation and triple glazed windows. However, a 2,236 square foot home in Washington would only require R-30 ceiling insulation, R-13 wall insulation and double glazed windows.

The energy budget numbers in Atlanta for the same 1,092 square foot house requires the same amount of insulation as Washington. This presents a situation of requiring the same amount of insulation for Atlanta and Washington for the same house, and less insulation in Denver. Yet the climate in Washington and Atlanta is much milder than that in Denver.

The following chart shows the differences for house designs of different living space (1092 square feet vs 1,822 square feet) for different cities. All of the differences listed are for houses heated with electric resistance heat.

DENVER, COLORADO (all Design Energy Consumption is in MBtu/sf/year)

Small House	Large House	% Difference
DEC 61.6	DEC 44.9	37.2%

MINNEAPOLIS, MINNESOTA

Small House	Large House	% Difference
DEC 118.8	DEC 104.2	14%

WASHINGTON, D.C.

Small House	Large House	% Difference
DEC 50.2	DEC 53.8	7.2%

ATLANTA, GEORGIA

Small House	Large House	% Difference
DEC 35.7	DEC 50.7	42%

Another result of the design energy budgets is that they assume all house types, regardless of size, shape, or foundation type, have the same energy consumption characteristics in any particular geographic area. DOE has apparently ignored the data that was developed by the NAHB Reserach Foundation, which clearly shows that there are significant differences in energy requirements due to house sizes and types. We recommended to DOE that separate budget numbers be assigned according to size, and depending upon whether the house is on a slab, over a crawl space, over a basement, or whether it is a bilevel, split level, one story or two story. Again, without separate numbers, smaller houses will be penalized creating an excessvie burden for young working families.

In addition, we have analyzed both interior and end unit townhouse designs in seven cities. In each case we calculated the design energy consumption of a reasonably typical townhouse design using the SET proposed by DOE. We have looked at the results for areas as widely diverse in both climate and location as Atlanta, Boston, Washington, D.C. and Seattle. The propsed budgets for single family attached residential buildings make no distinction between an interior unit with two exposed walls and an end unit with three exposed walls. We believe our analysis indictes a failure by DOE to recognize such differences thereby creating further inequities in the budget numbers.

The same inconsistencies in the budget numbers are also evident in multifamily buildings analyzed by NAHB. In most of these cities, it is possible to meet the BEPS requirements when gas heat is used with gas hot water. Individual metering is one of the most effective ways of conserving energy in multi-family buildings. The most cost effective solution to individual metering is all electric, which is prevented by BEPS in many instances by encouraging the use of oil and gas over electricity. We question DOE's rationale in this instance, when individual metering is easier to obtain with electricity. It is much more feasible to install electric hotwater heaters. This is the best method of providing hot water for domestic use in multifamily buildings. Such errors as these must be corrected and subjected to industry scrutiny.

WEIGHTING FACTORS

Perhaps the most outstanding error in the BEPS energy budgets is the inclusion of so-called weighting factors. Weighting the use of electricity, 75% of which is generated by noncritical coal, hydro power, and nuclear energy, at about three times that of gas and oil will not, by any means, help reduce our nation's dependence on foreign oil, but will prolong it. Electricity should not be penalized, but weighted to encourage its efficient use. Furthermore, it should be recognized that in many parts of the country electricity is the only fuel option available for heating and cooling new buildings.

The proposed rules will result in the elimination of electric resistance heat, even when the electricity is generated by noncritical resources such as hydro, coal and nuclear. This result of the proposed BEPS will adversely impact the customers of electric utilities. The heaviest burden will fall upon the individual ratepayer for both existing and new housing. The direct effect on the proposed weighting factors will be to increase the average electrical rate across the country. Most electric utilities are "summer peaking" and the additional winter load from electric heating of homes allows a lower year round rate. The proposed weighting factors will tend to severely restrict additions to the winter load resulting in higher rates for all consumers.

It is our conclusion that the impact of the weighting factors as propsed by DOE could be tantamount to a moratorium on any home construction in areas dependent on electric heating.

We have analyzed designs for large and small houses, and designs for townhouses according to the SET. Our analysis considered the climate of 15 cities, combinations of three detached and two attached residential designs. At least 174 different combinations of (1) wall, ceiling, and floor insulation (2) window glazing and window areas, (3) orientation, (4) foundation types, and (5) heating systems were considered.

NAHB is very concerned with the almost complete failure of homes with electric resistance heat to meet the budgets. In fact only 19 combinations of the 5 factors considered meet the proposed budgets with electric resistance heat. Virtually all of these are in Miami and Los Angeles where nearly all combinatins of insulation meet or exceed the BEPS requirements.

DOE seems to believe that whenever electric resistance heating can be displaced by a more energy efficient heat pump, the net effect will be positive. This is a misconception by DOE and should be modified for the following reasons:

(1). Electric heat is frequently chosen in a design because of heating demands that are intermittent due to local climate or space and use requirements of a specific design. In these cases, individually controlled baseboard electric heaters are low in first cost and frequently economical and efficient over the length of a heating season. (2). Baseboard electric or electric resistance strip heaters are also found where no air conditioning is desired or where they can efficiently supplement a central commercial system.

In commercial and multifamily buidings, electricity must be used for lighting, motors for fans, pumps, dampers, elevators, etc. This mandatory use of electricity, which the weighting factors penalize, on a three to one basis, could critically affect the energy budget.

If DOE wished to improve the overall residential fuel system efficiency in new homes, then the more rational approach would be to use the NAHB Thermal Performance Guildelines which take into consideration local climate, local energy costs and local expected cost increases. This approach equitably treats all types of house styles, foundation types and sizes. The approach also accounts for the varying efficiencies of different fuel choices.

There are too many instances of local variations in supply and price of various fuel types to have any reasonable expectation that a single set of national weighting factors will be equitable and enforceable.

For these reasons, it is NAHB's position that weighting factors, as currently proposed, be removed from the standards. While we support the concept of minimizing the overall use of our scarce natural resources, these areas of National Energy Policy are major national issues in themselves and should not be tied to a building energy performance standard.

If weighting factors must be included, they should be consistent with the realities of local public utility commission policies regarding new connections for natural gas and the existence of fuel oil companies able to serve new buildings. It does no good to have a weighting factors policy that encourages one fuel over another if it is physically impossible to select the favored fuel due to existing local restraints.

The need for more SMSA's with climate data, in the list of budget numbers, is clearly another important need in the proposed BEPS. In order to reduce the unfairness inherent in the proposed standards, it is important that the standards reflect the effect of local climatology on building design energy requirements. The proposed DOE scheme to change to the base of 60° F for Heating Degree Days is an unnecessary and further complication to an already complex procedure. Additionally, the use of the base of 50° F for the Cooling Degree Days seems to be a correction in the wrong direction without a sound technical base.

ECONOMIC ANALYSIS

DOE has estimated that BEPS will add $0.75 to $1 per square foot to the sales price of a house. We believe that the materials costs alone will amount to at least $0.75 to $1 per square foot. When the costs for design, increased permit fees, delays in construction, inspection, and overhead are added to this number, it can easily add more than twice the DOE estimate to the sales price of a typical house.

The increased housing costs that have been estimated by DOE are based on the assumption that the builder will sacrifice his time and money to determine how to comply with and implement BEPS. Rather than struggle through the complex and expensive evaluation procedure, the builder may simply include enough items in the design to make sure that the building complies with the standards without additional computer runs. This could further increase the construction cost beyond that estimated by DOE and force the consumer to pay for more energy conservation than is justifiable by any measure.

In justifying the use of a 30-year life cycle cost analysis, DOE admits that the marginal buyer will be forced out of the market. This issue needs to be put into perspective. It should be noted that fewer than 5% of the working families in this country can now qualify for the median priced new single family home. That percentage is down from 47% just ten years ago.

For those homebuyers who will not be forced out of the market, we assume that Congress will not want to be in the position of requiring them to pay for energy conserving features that will cost more than they actually save in reduced energy bills. As presently proposed, the BEPS will cost the new American homebuyer money, each and every month for the first few years that a house is occupied.

If a family stays long enough in their new house, and if BEPS really saves the amount of energy estimated by DOE, and if the cost of energy continues to increase as predicted, the new homebuyer could begin to actually save money from the BEPS standards after 10 or more years.

DOE should at least put the new homebuyer in a "break-even" position in the early years. At worst, the personal and individual impact on the new homebuyer should be that the cost of BEPS equals the value of the energy saved in the first year of occupancy.

Rural America, an organization which works to meet the housing and community needs of the rural population in this country, has stated that building costs due to BEPS for low income housing are likely to rise up to 7%. Rural America suggests that DOE accordingly advise federal agencies that subsidize low income housing, to request increased appropriations for these functions.

Every building design is assumed to be unchanged over 30 years. As energy prices rise, no allowance is made for such likely modifications as the addition of solar heat for hot water, installation of heat recuperators, adding wood stoves, shutters, night setback thermostats, etc. The life cycle cost analysis also totally ignores the fact that heating and cooling equipment and appliances do not last 30 years and that replacement equipment and appliances will be much more efficient than those that are intitally installed.

Since the BEPS computer program was used to prepare the economic analysis, we have compared the actual energy consumption of houses to the results calculated by the DOE-2 computer program. If the calculated consumption is incorrect, then any conclusions regarding the cost effectiveness of the energy budgets based on the computer calculations will also be incorrect. As shown in Table I, the SET predicts energy consumption that bears no relationship to actual metered data. Therefore, NAHB can conclude that the economic analysis done by DOE is meaningless from a practical viewpoint.

The DOE economic analysis is unrealistic because the projections of energy savings that were used are based upon typical building design practices in 1976 and not what is typical today. Thermal protection of houses built today is considerably higher than it was in 1976.

DOE estimates that BEPS will reduce national energy consumption, a total of 29 guadrillion Btus (29 quads) over the next forty years Current total U.S. energy consumption approximates 78 quads per year. Making the extremely conservative assumption that national energy consumption will not increase over the next forty years, we estimate that the nation will consume 78 quads per year for the next 40 years or a cumulative total of 3120 quads. Given DOE's estimate of energy savings due to BEPS of 29 quads over the next forty years, it is clear that BEPS is projected to impact total national energy consumption by less than 1% over the next 40 years.

The costs of BEPS cannot fully be examined until an implementation program has been scrutinized, but NAHB has performed some analysis on projected costs stemming from material costs, permit fees, etc.

The minimum private cost of BEPS could be estimated as follows: 2.0 million housing starts per year, having an average of 1755 square feet in each house would require an additional expenditure of $3216 as shown in Table II. By simple multiplication this minimum cost on the residential industry will be $6.432 billion per year.

Assuming DOE's estimate of energy savings from BEPS of 216,000 barrels of oil per day by 1990 is correct, and assuming that 25% of this savings is achievable in the first year of implementation, the value of the energy saved in the first year, at a cost of $30 per barrel, would be $591 million. This means that BEPS would result in a net cost to the nation of $5.841 billion in the first year of implementation.

Even assuming that as energy prices rise each year, as they certainly do, this cost in the first year, and the next 10 years will not be worth the minimal amount of energy saved. In light of these figures, it seems obvious that BEPS as presently proposed is a highly questionable energy saver and is not cost effective by any means.

IMPLEMENTATION

The issue of how the standard will be implemented is an extremely critical element of any potential energy savings from BEPS. In order for the building community to have an adequate opportunity to respond to the proposed standards and their potential impact, the implementation program must be analyzed and recommmendations for changes be made in conjunction with comments on the proposed standards themselves. However, the present time table set by DOE indicates that the standards will be finalized before the building community has an opportunity to comment on an implementation plan. Questions of cost and liability cannot be fully answered unless it is clear what steps and procedures will be required to comply with the standards. This compressed time frame seems highly unrealistic. We concur with the conclusion of the National Institute of Building Sciences that:

> "because of existing constitutional, legislative and statutory requirements many states and local jurisdictions will require at least 3 years to adopt and effectively implement BEPS. Further, the private sector will require substantially more than 12 months to become proficient in the application of the standards and to build up inventories of the equipment and materials required to meet the BEPS requirements."

The Congress in P.L. 94-385 stated that existing building codes would be a desirable method for incorporating the new standards. Since the enactment of P.L. 94-163, which mandated that states develop energy plans, 44 states have implemented some form of building code or standard for energy conservation in buidings. Many state governments are just beginning to implement these codes. The BEPS should build on these codes so as not to waste the time and expense put into them by state governments. In light of the work already begun by the states on the model energy codes, the BEPS would be most useful if they could be worked into existing energy codes.

These factors point with certainty to the fact that the timetable under which DOE is operating is entirely unrealistic. The amount of time for promulgation and implementation is simply unrealistic. DOE needs at least two years to complete the essential additional research work on BEPS to make them workable, understandable and cost effective. We therefore support the provision in S.2719 which would extend the promulgation period for BEPS up to two years, to allow the essential additional research work on BEPS to be completed. We also concur with the National Institute of Building Sciences that state and local governments will need up to three years to fully implement BEPS. Publishing the standards now in their present state would only add confusion and cost to the states effort to adopt their own energy efficient building codes. A multistate pilot program would be helpful to determine the resource that states and localities will need to adhere to such an energy performance standard. DOE has already demonstrated that it cannot effectively monitor the states compliance with energy standards. We realize the standards cannot be made technically perfect but they should make sense. The workshop conducted by NIBS produced a near unanimous opinion from the building industry that the BEPS promulgation must be delayed well beyond its present statutory time table.

CONCLUSION

The impression created by those who favor rapid promulgation of BEPS at any cost, that a delay in promulgation equals an opposition to energy conservation, is false and self serving. After all, DOE in its own estimates now suggests that BEPS will save less than 2% of the energy savings predicted to the Congress in 1976. The Administration itself is divided over the question of whether BEPS is the correct approach. The President's Council on Wage and Price Stability on behalf of the Regulatory Analysis Review Group urged DOE to reassess the need for BEPS, and that a delay in the promulgation of the standards was needed at a mininum. The standards as presently proposed will not work. DOE should complete the necessary research work on BEPS and take advantage of the technical resources of the building community as the Congress originally intended.

NAHB favors an energy performance standard and is willing to work with the federal government to develop standards that make sense and save energy at a reasonable cost to the nation.

TABLE I

COMPARISON OF SET RESULTS AND ACTUAL METERED DATA

	Actual Metered (kwh)	Calcualted by DOE -2A (kwh)
Heating	3422	6146
Cooling	1610	1087

-Based on EER test house built under contract for HUD. Residence is 2392 sq. ft. and located in Mt. Airy, Maryland.

-Calculated total is adjusted for actual SPF of 1.9 of equipment in residence.

-Calculated is also adjusted for 5460 degree days vs 4240 for Washington, D.C. weather tapes

-On cooling calculations, results are adjusted for actual EER of equipment used, i.e. 6.84

-Metered results are for a typical cooling season and heating season

TABLE II

BEPS ECONOMIC IMPACT ON THE RESIDENTIAL BUILDING INDUSTRY

I. INDIVIDUAL BUILDER LEVEL

For the majority of builders, BEPS will require a one-time educational effort to understand the design, evaluation, and compliance requirements of the new standard. This effort will be necessary for any personal involvement with the product design, financing approvals, or permit processing of new buildings, including houses.

On the average, two key persons will require a minimum of 50 hours of education. $10,000

Construction drawings will need to be modified, field specifications for certain trades, i.e. insulation, framing, HVAC, windows, and doors, and field personnel will have to be re-instructed as to the field procedures necessary for complaince. A one-time lump sum cost of $10,000 is a reasonable expectation. $10,000

An additional inspection will have to be planned for and complied with. The cost for this is low, but it is a repetitive cost that will apply to all future houses. An estimate of this cost, including inspection fees is . .$50/house

The construction requirements of the standards will need to be implemented in the field. This will include such costs as increased insulation, more efficient equipment, different designs for different orientations of the same model house, larger, or relocated overhangs, or better quality windows and doors. In lieu of these types of compliance costs, it may be the choice of the builder to add solar domestic water heating systems. This cost is estimated by DOE to be 75 cents to $1 per square foot. NAHB estimates this cost to be approximately $2,500/house

Summary of per house effect on typical small builder members of NAHB. Lump sum costs are spread over a typical two year volume of 30 houses (2 years x 15 houses/year)

Education of key personnel	$333/house
Revision of Drawings, New Field Procedures	$333/house
Additional Inspection	$ 50/house
Hard Cost to Comply with Standards	$2,500/house
TOTAL	$3,216/house

NATIONAL ASSOCIATION OF HOME BUILDERS,
Washington, D.C., August 20, 1980.

Hon. J. BENNETT JOHNSTON,
Chairman, Subcommittee on Energy Regulation, Committee on Energy and Natural Resources, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: Enclosed are NAHB's Thermal Performance Guidelines[1] and answers to two questions posed by you to our witness during the Subcommittee's hearing on the Building Energy Performance Standards (BEPS) on June 5, 1980. As mentioned in our testimony, the NAHB Thermal Performance Guidelines are a voluntary energy standard developed over four years by NAHB members and staff. It is a voluntary energy guideline that is sensitive to local energy prices and climate.

Please let me know if you have any further questions.

Sincerely,

ROBERT D. BANNISTER,
Senior Staff Vice President.

[Enclosure.]

Question 1. Regarding the issue of sanction and enforcement of BEPS, what is your opinion of a warranty by the builder as a means of compliance, rather than the present sanctions being discussed?

Answer. NAHB is opposed to any type of warranty by the builder as to compliance with BEPS. We feel it is impossible at the present time to endorse the notion of warranting a standard that has been universally found to be unworkable, costly and unable to produce any significant savings of energy. Warranting compliance with BEPS would be in effect warranting an energy consumption figure for each building designed in accordance with the standards. As energy consumption for a particular building design can vary greatly depending on lifestyle and the number of occupants, such a warranty will present many liability problems for the builder. Even if the warranty specified that the builder was only guaranteeing the design energy consumption of a particular building, legal action would likely be brought against builders for those homes where the actual energy consumption exceeded the estimated design energy consumption.

A much preferable method of assuring compliance with the BEPS would be for states and local units of government to voluntarily adopt the standards and to incorporate BEPS with their building codes and standards.

Question 2. What are some intermediate steps that can be taken to have a real trial of the proposed standards without putting the builders out of business, but easing them into the standards?

Answer. The only way that a trial of the proposed standards can be achieved without disrupting the entire industry would be to enlist certain states and localities to participate in such a trial program on a voluntary basis. Several states have already expressed interest in such a demonstration program. These states and their local units of government, rather than adopting the standard in total, would apply it to a certain sampling of the construction being built under their jurisdiction. Local home building associations could be helpful in identifying construction samples.

Such a test program would have as its primary responsibility to determine that the standards as promised by DOE are workable and will not cause delay and undue expense in the traditional construction process. Of equal importance would be the program's attempt to determine the amount of energy savings that could accrue from BEPS. The test program should also address such fundamental issues as comparing BEPS to prescriptive standards, and ways of encouraging simplified compliance procedures. The test program should span at least one year so as to include all climate variations. A successful test program would prepare states and builders for an eventual transformation to a performance standard.

Financial assistance from DOE for the state, localities and builders participating in such a program will be necessary to prevent any burdensome costs from the proposed standards from adversely affecting participants.

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[1] See appendix II.

Senator JOHNSTON. We have a very outstanding panel again this morning with our good friend George Lawrence with AGA, and Bill McCollam with Edison Electric.

Gentlemen, we will be starting with you, George.

STATEMENT OF GEORGE H. LAWRENCE, PRESIDENT, AMERICAN GAS ASSOCIATION, ACCOMPANIED BY ARTHUR W. G. JONES, MANAGER OF CODES AND ORDINANCES, SOUTHERN CALIFORNIA GAS CO.; KENNETH CUCCINELLI, ENGINEER; AND DAVID CONOVER, ENGINEER

Mr. LAWRENCE. My name is George Lawrence. I am president of the American Gas Association. I am accompanied today by Mr. Art Jones who is manager of codes and ordinances of the Southern California Gas Co., and also Mr. Cuccinelli and Mr. David Conover, engineers.

I have a detailed statement that I would like to offer for the record.

Senator JOHNSTON. That will be put in the record.

Mr. LAWRENCE. Also we have a very brief prepared statement of three pages from Mr. Jones which we also ask be included in the record.

[The prepared statements of Mr. Lawrence and Mr. Jones follow:]

TESTIMONY
OF
GEORGE H. LAWRENCE,
PRESIDENT
THE AMERICAN GAS ASSOCIATION
BEFORE THE
SUBCOMMITTEE ON ENERGY REGULATION
OF THE
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
ON THE
DEPARTMENT OF ENERGY'S
PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS

June 5, 1980

George H. Lawrence,
President
The American Gas Association
1515 Wilson Boulevard
Arlington, Virginia 22209
703/841-8400

best copy available

TESTIMONY OF
GEORGE H. LAWRENCE, PRESIDENT
OF THE
AMERICAN GAS ASSOCIATION
BEFORE THE
SUBCOMMITTEE ON ENERGY REGULATION
ON THE
DEPARTMENT OF ENERGY'S
BUILDING ENERGY PERFORMANCE STANDARDS

June 5, 1980

Mr. Chairman and Members of the Subcommittee:

I am George H. Lawrence, President of the American Gas Association (A.G.A.). A.G.A. is a national trade association composed of nearly 300 natural gas transmission and distribution companies serving all 50 states. Collectively, A.G.A. member companies account for nearly 85% of the annual natural gas utility sales in the United States.

A.G.A. welcomes the opportunity to testify on the Department of Energy's proposed Building Energy Performance Standards (BEPS). Our industry has historically supported energy conservation as a prime means of lessening this nation's reliance upon foreign sources of oil as well as reducing needless consumption of domestic energy resources. We believe the BEPS will further this goal.

A key feature of the proposed BEPS is the weighting factor concept which accounts for the energy consumed in the energy cycle; i.e., efficiency in energy production, transmission, generation, distribution and end use. A.G.A.'s support of the proposed BEPS is based upon this crucial means of treating all energy forms on an equivalent basis.

Our purpose in appearing before you today is to make the following general points regarding the BEPS:

- The weighting factor concept, which is the core of BEPS, is consistent with statutory and regulatory authorities and is consistent with the laws of thermodynamics. Consequently, A.G.A. supports the weighting factors concept contained in the proposed BEPS.
- There are a number of misconceptions which have surfaced recently regarding the BEPS. We intend to dispel some of these misconceptions in our testimony.
- A.G.A. is strongly committed to a national energy policy which encourages conservation through the efficient use of all energy sources. To the extent that BEPS will accomplish this goal, the BEPS should be implemented without delay.

A.G.A.'s specific comments follow.

' The Weighting Factor Concept

DOE proposes the use of weighting factors that account for the costs of fuels and the value to the nation of conserving different energies. A.G.A. strongly supports the inclusion of the weighting factor concept in the proposed BEPS as a means of assessing energy use on an equivalent basis. Without such an equivalent methodology for equating the Btu consumption of a proposed building, only a portion of the energy use is counted. Such a policy penalizes equipment that burns fossil fuels inside a building and violates the intent of the ECPA by rewarding energy inefficiency.

Misconceptions Regarding the BEPS

Since the proposed BEPS were published in November, 1979, a substantial amount of controversy has arisen focusing on several key aspects of the BEPS. Among the misconceptions which have surfaced in this time frame are:

- The BEPS will significantly increase the first cost of residences and will eliminate many prospective homebuyers from the housing market.

- The BEPS will encourage oil and gas imports and thus are contrary to national energy policy.
- The BEPS weighting factors dictate the builder's fuel choice for new homes.
- By encouraging the use of natural gas over other fuels, the BEPS have ignored the doubts of some parties regarding the supply outlook for natural gas.
- The BEPS will preclude the use of our abundant coal reserves.
- The BEPS, as performance-based standards, will be unworkable and overly complex.
- The weighting factors strongly discourage the use of electricity in new buildings.
- The weighting factors do not distinguish among primary fuel choices for electrical generation.
- By discouraging the use of electric power, the BEPS will prevent electric utilities from balancing their present loads.
- The weighting factors are resource based and are, therefore, inconsistent with the statutory requirements of ECPA, which mandates an on-site energy use evaluation.
- Weighting factors are contrary to the National Energy Policy.
- The BEPS will create significant liability exposure for professional engineers who design buildings to comply with BEPS.
- The BEPS will create confusion in states and local governments which have already adopted building energy codes.

Each of these points warrants a close examination. The following is A.G.A.'s rejoinder to each of these misconceptions:

The BEPS and Increased First Costs for Residential Buildings

Although no actual data are available, current estimates of the increased "first cost" of a new home due to additional construction materials and implementation required by the BEPS range from $1,000-$2,500 per single family home. For a $60,000 home this cost represents a 1.7% to 4.2% increase in the base price. This is not an out-of-pocket cost, however, in that only a minor portion of the first cost (i.e., between 5% and 20%) is required for the downpayment on this new, more efficient house. The remainder of the cost due to the BEPS would be included in monthly mortgage payments. For example, a $1,500 BEPS cost on a $60,000 home with a 10% downpayment and 13% interest rate will cost the homeowner an additional $15 per month, a cost that would be completely offset in 5 years or less by reduced monthly heating bills if the BEPS resulted in a 30% energy savings for the new structure.

Further, evidence indicates that homeowners are willing to pay for energy efficiency in their homes. In the first quarter of 1980, over 40,000 homeowners invested between $750 and $2,500 each to convert their oil heating systems to natural gas in order to avoid future increases in the price of heating oil. A.G.A. estimates that over 200,000 voluntary conversions per year will take place during 1980 and 1981. Clearly, concern about rising fuel prices has made many homeowners aware of the need for energy efficiency in their homes and offices. These customers can see the future value of investments in conservation made today.

Homeowners are also adding insulation and energy efficient equipment to their homes in substantial numbers. According to the DOE's Residential Energy Consumption Survey, over 1.0 million housing units added expensive insulation and conservation equipment, such as storm windows or new waterheaters, during 1978. Improvements such as these can cost at least $1,000 and frequently more.

The BEPS and Imported Energy

Natural gas is essentially a domestic resource. In 1979, the U.S. produced 19.9 Tcf of gas, while importing only 1.2 Tcf. Domestic gas production was 94% of our total supplies. In contrast, nearly 15% of our electricity production came from oil-fired powerplants. We also directly imported .2 quads of electricity -- approximately 3% of our domestic production. Therefore, while both electricity and natural gas are primarily domestic fuels (97% of our electricity and 94% of our natural gas produced in the U.S.), an appreciable portion of domestic electricity production uses foreign oil as a feedstock.

The Mellon Institute, in a recently published study entitled The Least Cost Energy Strategy examined the relationship between energy use patterns and foreign oil imports. That report concluded that conservation of all fuels in the building sector was essential to backing-out foreign oil imports. Of particular importance, it showed how reduced electricity consumption in buildings could free-up natural gas for high priority uses that would have been otherwise used in powerplants and significantly reduced oil imports through reduced oil consumption by electric powerplants.

In summary, natural gas production is primarily domestic, with most new marginal supplies coming from U.S. production (e.g., Alaskan pipeline gas, coal gasification, gas from unconventional foundations and land fill gas). In contrast, marginal electricity production uses either imported oil or natural gas as a feedstock. In addition, the direct importation of electricity has increased dramatically since 1975 (up over 300%) and continues to rise.

In fact, from a balance of trade perspective, natural gas and direct electricity imports were roughly equal in 1979.

The BEPS and the Builder's Fuel Choice

The BEPS do not dictate an energy fuel choice. By definition, a performance standard selects or establishes a goal to be accomplished. It does not prescribe the method by which that goal is to be realized. In the case of BEPS, a maximum design energy consumption level is the performance standard. The means by which that standard is met are left to the building designer, who must have an energy system designed in any event. The BEPS will result in reduced energy consumption and lower consumer costs without dictating the fuel choice or energy system to be employed in obtaining the performance-based goal.

The BEPS and Gas Supply Availability

A.G.A. supply estimates indicate that natural gas will be in plentiful supply for use in residential, commercial, and industrial sectors well into the foreseeable future. In addition to conventional sources of natural gas, synthetic fuels and other unconventioanl sources of natural gas will be available to supplement existing natural gas reserves.

Furthermore, if the building designer/builder feels that there is an inadequate supply of any fuel choice, he/she is not precluded by the BEPS from choosing any other fuel. As stated above, performance standards merely establish energy performance goals and do not prescribe the methods (or the fuel choices) by which the goal is achieved.

It should be noted that a strong gas supply response to the wellhead price incentives in the Natural Gas Policy Act (NGPA) is already evident. Relative to 1978, all of the indicators of increased production -- i.e., seismic activity, other exploration and drilling activity, and rig counts -- improved impressively during 1979. Also, reserve additions have recently reached the highest level in 12 years.

The BEPS and Coal Use

The BEPS, as a performance standard, will not prevent the use of coal or any other form of energy. If coal-fired electric power is used, the BEPS merely set a reasonable energy consumption level for any building using coal/electric power. With regard to coal gasification, the BEPS, by accounting for efficiency in the energy delivery system, could encourage the efficient use of coal in today's existing gas pipeline system. Major benefits of coal gasification compared to other uses of coal include ease of handling and minimal environmental impact.

It should be added that A.G.A. is working actively to encourage the select use of gas as a means to enhance coal conversion. If gas is burned in conjunction with coal in an appropriate proportion of simultaneous or alternating use, increased emissions from direct coal combustion can be mitigated -- with the result that direct coal use can be made environmentally more acceptable.

The BEPS and Their Practical Application

In the case of residential and small commercial construction, DOE has indicated that existing prescriptive energy codes, if considered equivalent, will be allowed to regulate building energy design in place of BEPS implementation. These equivalent codes would eliminate any need for conducting a performance based energy analysis on a proposed energy design.

Existing energy codes currently require two annual energy analyses to determine compliance: first, on the building as proposed; and second, on the building itself, assuming that it meets the minimum prescriptive code provisions. By contrast, BEPS would simply require one annual energy analysis. Furthermore, if future building designs are similar to one approved under the BEPS, additional analyses would be unnecessary, since the general building design would be the same. Current codes, on the other hand, would still require two analyses, since compliance is achieved on a building-by-building basis.

The state of Florida has recently enacted a performance standard which includes weighting factors. This Florida format is quite simple, and it requires approximately 20-30 minutes of time for completion by the builder. In California, a BEPS standard has been in effect for two years. Outside of the U.S., Canada and several European countries have implemented building energy standards using performance approaches which have been working successfully. The performance approach allows more flexibility to the designer to reduce the overall energy consumption without inhibiting innovative building design.

The BEPS' Weighting Factors and Electricity

The weighting factors do not prescribe a specific fuel choice; rather, the weighting factors merely place energy usage and operating costs on an equivalent basis by taking resource energy consumption from source through final distribution into consideration. The

BEPS do not discourage the use of any fuel; rather, they encourage the most efficient use of our energy resources -- which is clearly in the national interest.

The BEPS' Weighting Factors and Fuel Choices for Electrical Generation

While the BEPS weighting factors do not specifically address the variety of fuels (and their respective efficiencies) which can be used in the generation of electricity, the costs of electricity in deriving the weighting factors reflect the fuel mixes. For example, in the Northwest, where hydro-electric power is available, the costs for electricity would be low. On the other hand, in areas of the country where electrical generation is dependent upon oil or nuclear energy, the costs for electricity would be high. Thus, weighting factors implicitly account for the energy lost in the transmission, generation and distribution of electricity. While various fuel mixes will result in different generating efficiencies, the national average efficiencies for electric generation, according the the Edison Electric Institute statistics, have not varied more than 5% in the past 25 years. In order to accommodate regional deviations from the national average, A.G.A. would support efforts to adjust the BEPS in order to take regional factors into account -- provided that the concept of resource-based weighting factors is retained. In essence, regardless of the fuel mix for electrical generation, the average efficiency of electrical generation has not changed very much in the past 25 years, making the fuel mix argument non-persuasive.

The BEPS and Electricity Load Balancing

With the BEPS, for electricity, the relative proportions of winter-to-summer demands will remain basically the same. Electric utilities which desire to balance their seasonal loads should concentrate on making new and existing structures more energy efficient. A.G.A. believes that the most prudent policy would be the promotion of greater efficiency during the summer demand "peaks" -- rather than the encouragement of greater inefficiency during the winter demand "valleys". BEPS should not be used as a means of artificially increasing consumption.

increasing consumption.

It should be noted that a number of Northern electric utility systems now have winter demand peaks. We suggest that an alternative to increasing electricity demand during the winter is to increase the use of gas air conditioners and accelerate the development of gas-fired heat pumps as a means to reduce electricity demand during the summer.

The BEPS' Weighting Factors and Statutory/Regulatory Precedents

As we stated previously, there are significant statutory and regulatory precedents supporting resource energy efficiency as being the basis for BEPS evaluation of energy efficiency. The legislative history of ECPA does not reveal any Congressional intent to limit the standard to on-site efficiency. Furthermore, ECPA requires that any energy efficiency standard be cost-effective. By implicitly recognizing the natural resource consumption of new construction, the BEPS are consistent with: 1) the statutory intent of ECPA; 2) other related statutes and regulations dealing with energy efficiency; and 3) established thermodynamic principles.

The BEPS' Weighting Factors and National Energy Policy

A national objective is clearly reduced reliance upon imported oil. It is also in the nation's best interest to reduce energy consumption within the United States by using our energy as wisely as possible. Weighting factors are essential in determining the effects of various decisions on natural resources because for a given fuel, weighting factors provide insight regarding the total energy cycle efficiency (i.e., the overall efficiency of energy production, transmission and distribution).

The BEPS and Engineer Liability

The BEPS are designed as energy performance standards only insofar as building design is concerned. The BEPS are not designed to be used as predictive tools. The standard building operating conditions under which the designs are evaluated can never be duplicated in real practice, since these conditions do not include the effects of individual lifestyles. In other words, BEPS creates a uniform set of building assessment standards against which various building system designs can be compared. Like the EPA mileage estimates, of course, this is only a measure for comparing one building design to another.

The BEPS and State/Local Building Codes

Forty four states have adopted ASHRAE Standards 90-75 or the Model Energy Code for energy conservation as their state building energy codes. There has been significant discussion in hearings before DOE that existing state energy codes such as those based on ASHRAE 90-75 should be granted equivalency status. To the extent that this equivalency is granted to ASHRAE 90-75 and other model building energy codes, the BEPS will only add to the choices which are available in designing a code-complying building.

Prompt Implementation for BEPS

Under ECPA DOE is required to issue its final rule by August 14, 1980. The President will then transmit the rule to Congress for consideration, along with any provisions for sanctions. Both Houses of Congress must approve any sanctions contained in the BEPS.

While the possibility of an extension on the August 14, 1980, deadline has been rumored for some time, these rumors were confirmed recently when Representative Ashley (D-OH) offered an amendment to H.R. 7262 (the HUD authorization bill) which would extend DOE's deadline for promulgating the BEPS to August 2, 1982. Conservation is in the national interest and should be given a national priority. Since BEPS will encourage conservation, the postponement of an effective BEPS rule could be inconsistent with the national interest. Indeed, we can see no reason why implementation of the BEPS will be any more "convenient" in 1982 for opponents of the rule than its promulgation in 1980 would be. Delay in BEPS promulgation simply can serve no other purpose than to foster energy waste for two more years. To allow an extension of any sort in BEPS implementation will be to pay lip service to the goal of making conservation an integral part of our national energy policy.

A.G.A. considers it premature at this time to adopt a position on the possible imposition of mandatory sanctions for non-compliance with the final BEPS regulations. Nevertheless, we do wish to note that both Houses of Congress will have an opportunity to vote on the question of mandatory sanctions after the final BEPS regulations have been issued. Since Congress has reserved for itself the authority to be the ultimate arbiter of this issue, there is no basis for believing that a delay of BEPS implementation is necessary in order to prevent the adoption of mandatory sanctions. The two issues are separate and distinct from each other.

Statutory Authorities

In some quarters it has been asserted that the concept of source-based standards is inconsistent with the ECPA and regulatory precedent. This is not the case, however.

Congressional endorsement of the use of resource-based energy efficiency standards can be traced to the Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. Section 5901; the "ERDA Act").

The ERDA Act was an expression of Congressional concern over the energy shortages and economic dislocations experienced because of the 1973 oil embargo. In addition, Congress recognized potentially disastrous consequences which would result from the failure to conserve nonrenewable energy resources coupled with the failure to develop alternative fuel sources which would be economically competitive with those nonrenewable energy resources. (1974 U.S. Code Cong. & Ad. News 6861, 6876). Consequently, §5902 and 5903 of the ERDA Act created the Energy Research and Development Administration and vested the Administrator of ERDA with authority to implement the programs created by the ERDA Act. These functions have since been transferred to the Department of Energy. (42 U.S.C. §7151).

Conservation is one of the stated purposes of the ERDA Act, and Congress enacted principles which embody this conservation theme and which govern all Federal participation under the ERDA Act.

Section 5904 contains these principles governing research, development and demonstration programs, among which are the following:

> (a)(1) Energy conservation shall be a primary consideration in the design and implementation of the Federal Nonnuclear Energy Program. For purposes of this chapter, energy conservation means both improvement in efficiency of energy production and use, and reduction in energy waste.
>
> (5) The potential for production of net energy by the proposed technology at the stage of commercial application shall be analyzed and considered in evaluating proposals. [Emphasis added.]

These principles reflect the intent of Congress that energy efficiency be determined by the amount of natural resources which actually reaches the ultimate user. This determination must account for energy losses from point of production through the transmission, generation and distribution system (an analysis which is referred to as the "net energy analysis"). The attached article from The Wall Street Journal (May 3, 1979) compares the net energy analysis with a site-based energy analysis. (Attachment No. 1). We are also attaching a portion of ERDA's 1976 National Plan for Energy Research, Development & Demonstration in which the net energy analysis is amplified. ERDA 76-1 (1976).

Section 5904 reflects Congressional preference for the net energy analysis and the ERDA Act's legislative history supports this interpretation. The Senate Report describes the primary policy objective as being to encourage conservation of natural resources:

> . . . through more efficient development, production, conversion and use of energy resources.
>
> Noting that primary energy resources are both nonrenewable and limited by natural and geological factors, the objective is to optimize their long-term benefits for society through improvements in all aspects of the energy supply system from the standpoint of conservation and efficiency. The premise is that waste of energy resources as a result of this inefficient use must be viewed as contrary to the public interest from the standpoint of overall societal, economic, and environmental concerns. S. Rep. No. 589, 93d Cong. 2d Sess., reprinted in [1974] U.S. Code Cong. & Ad. News 6876. [Emphasis added].

Thus it appears that the Senate considered that, for purposes of measuring conservation, the amount of resources lost or wasted is of significance in the measure of energy efficiency.

The Federal Power Commission (FPC) echoed this consideration in its comments on the ERDA Act. In discussing the research and development programs designed by the ERDA Act, the FPC suggested that these programs should develop new technologies capable of mitigating the loss of resources which now occurs in energy conversion technologies (e.g., electrical generation):

> Another fundamental requirement of the energy R&D Program should be an emphasis on energy conservation, developing a technological capability sufficient to substantially improve the conversion of primary energy resources and electricity.
>
> However, excluding the breeder reactor, the present state of conversion technology leaves much to be desired. There is about a 70-percent loss in energy efficiency through conversion to electricity by fossil-fuel steam electric plants. Additionally, there is about a 10-percent loss in kilowatt hours between the generating plant bus bar and the electricity-consuming appliance. [1974] U.S. Code Cong. & Ad. News 6892, 6893. [Emphasis added].

A final indicia of Congressional ratification of the net energy analysis as a standard of energy efficiency can be found in the Joint Explanatory Statement of the Committee of Conference:

> *The intent of the principles set forth in paragraph 5(2)(5) is that in the assignment of priorities for Federal encouragement of commercial applications of new energy technologies, consideration should be given to the net as opposed to the gross, energy yield. The processes and facilities necessary to produce energy also consume energy, and in the case of certain technologies, this consumption may account for a substantial portion of the potential yield of the energy resource. Efficiency in every step of energy production, transmission, and utilization is important.*
>
> H.R. Rep. No. 1563, 93d Cong., 2d Sess., *reprinted in* [1974] *U.S. Code Cong. & Ad. News* 6906, 6907. [Emphasis added].

Thus, there'is ample support in the ERDA Act's legislative history to support the conclusion that this Act requires DOE to analyze any request for Federal participation on the basis of the proposal's net energy (*i.e.*, resource-based) efficiency.

Two other statutory bases supporting the use of source- or net-energy efficiency standards are:

- The Energy Policy and Conservation Act (P.L. 94-163; "ECPA"); and,
- The Energy Conservation and Production Act (P.L. 94-385; "ECPA").

Although neither statute recognizes explicitly the source energy efficiency requirements set out in the ERDA Act, their legislative histories reveal a recognition of the significance of resource energy efficiency.

DOE's immediate regulatory predecessor, the Federal Energy Agency (FEA), presented testimony on EPCA before the Energy and Power Subcommittee of the House Committee on Interstate and

Foreign Commerce in 1975. The significance of source-energy efficiency was recognized in the testimony of Dennis W. Bakke, FEA Deputy Assistant Administrator for Energy Conservation and the Environment, who said:

> *There are substantial energy inefficiencies in this sector, not only in the generation of electricity, but also in its transmission, local distribution and end use*. . . . On the one hand, we must insure the capability of utilities to supply adequate electricity to the Nation at reasonable prices. On the other hand, *we must conserve energy by minimizing the inefficiencies and wastage which occur not only in the consumption of generator fuels, but also in the ultimate consumption of electricity itself*. H.R. 94-18, at 1540. [Emphasis added].

In discussing the purposes of EPCA contained in Section 2, the House Report from the full Interstate and Foreign Commerce Committee similarly recognized the importance of recognizing source energy efficiency:

> The use of natural gas for space heating and substitution for electricity generated by natural gas can result in a significant decrease in natural gas consumption -- according to some estimates 60 percent less natural gas is required to produce heat for a home if gas space heating is used rather than space heating using electricity generated from natural gas. H.R. Rep. No. 340, 94th Cong. 1st Sess. 102, *reprinted in* [1975] *U.S. Code Cong. & Ad. News* 1856.

In the development of energy labeling and efficiency standards for certain consumer products (Title IV of EPCA), the House focused on energy consumption in the residential sector for major appliances:

> . . . improving the energy efficiency of major appliances can result in major reductions in net energy consumption, and because of extensive residential use of electricity, also in primary energy consumption. *Id.* at 102, *reprinted at* 1856.

The House specifically recognized that it was not using the term "net energy" as that term had been used in the ERDA Act. The term "net energy" at this point in the House Report is referring to site-based energy efficiency and not resource-based energy efficiency. Id., note 12.

DOE's statutory mandate to develop and promulgate the BEPS is found in the ECPA. While the legislative history of this Act does not reveal any detailed consideration of the methodology for determining energy efficiency, significant consideration was given to developing cost-effective conservation standards. In hearings before the Energy and Power Subcommittee of the House Committee on Interstate and Foreign Commerce, Roger W. Sant, Assistant Administrator of Energy Conservation and the Environment of the FEA, stated:

> The criterion of cost-effectiveness was applied to our conservation and environmental efforts. Specifically in the conservation area only those actions that would save energy at a cost lower than the cost of available energy supplied were considered relevant opportunities. H.R. 94-119, 94th Cong., 2d Sess., at 310.

The FEA witness was describing the standard against which any proposed project was evaluated in terms of justifying Federal participation under the ERDA Act. Indeed, cost-effectiveness as a criterion is closely related to the evaluation of a project's contribution from a resource energy efficiency perspective.

Although the ERDA Act is the only statute which contains specific language embracing the source-based energy efficiency standard, the legislative histories of three Acts (i.e., the ERDA Act, EPCA and ECPA) clearly reveal a definite Congressional attitude supporting resource-based efficiency standards. Based upon the ERDA Act and upon the statements contained in the legislative histories of EPCA and ECPA, A.G.A. believes that resource-based energy efficiency considerations must be applied by DOE in developing and promulgating the BEPS.

Regulatory Authorities

As we stated in our introductory remarks, the following regulations recognized the significance of measuring efficiency at the source:

- 10 C.F.R. Part 420 -- State Energy Conservation Plan;
- 10 C.F.R. Part 216 -- Materials Allocations and Priority Performance under Contracts or Orders to Maximize Domestic Energy Supplies;
- 10 C.F.R. Part 450 -- Energy Measures Energy Audits;
- 10 C.F.R. Part 595 -- Certification of Use of Natural Gas to Displace Fuel Oil; and,
- 10 C.F.R. Part 711 -- Guidelines for Environmental Review.

Of these regulations, the most significant recognition of source-energy efficiency can be found in the regulations governing the State Energy Conservation Plan (10 C.F.R. Part 420). The definition of "energy conservation" leaves no room for interpretation with regard to the manner in which conservation is to be measured:

> "Energy conservation" means energy conservation, efficient energy use or the utilization of renewable energy resources which result in energy savings based upon a net reduction of nonrenewable energy resources. 10 C.F.R. Section 420.2(c). [Emphasis added].

Similarly, the regulations governing "Energy Measures Energy Audits" (10 C.F.R. Part 450) specifically require that energy use be calculated using conversion factors which implicitly recognize the source energy efficiencies of various energy sources. These conversion factors are as follows (from 10 C.F.R. 450.42):

- electricity -- 11,600 Btu per kilowatt hour;
- natural gas -- 1,030 Btu per cubic foot;
- distillate fuel oil -- 138,690 Btu per gallon;

- residual fuel oil -- 149,690 Btu per gallon;
- coal -- 24.5 million Btu per standard short ton;
- liquefied petroleum gases (including propane and butane) -- 95,475 thousand Btu per gallon; and,
- steam -- 1,390 Btu per pound.

The statutory authority underlying the Energy Measures and Energy Audits regulation is found in Part B of Title IV of ECPA.

The General Services Administration (GSA) likewise recognized the importance of analyzing energy efficiency based upon source-energy efficiency standards. In its Energy Conservation Guidelines for Existing Office Buildings, GSA uses an energy efficiency factor for electricity which recognizes the significance of resource losses which occur in the transmission, generation and distribution of electrical energy. General Services Administration, Energy Conservation Guidelines for Existing Office Buildings (2d ed. 1977), at 1-5.

On the basis of the foregoing analysis of the relevant statutory authorities and the relevant regulatory authorities dealing with energy efficiency and energy conservation, A.G.A. believes that DOE is required to recognize resource-based energy efficiency factors in developing, promulgating and implementing the BEPS. The weighting factor concept implicitly recognizes the importance of evaluating energy consumption on an equivalency basis. To this end, DOE has proposed performance standards which are consistent with the intent of ECPA and other existing statutory and regulatory authorities. A.G.A. commends and strongly supports DOE in the utilization of resource-based energy standards.

Authorities Based on Physical Laws

Aside from the regulatory aspects associated with resource energy use, the laws of nature preclude any energy-consuming system from creating energy or being over 100% efficient. On-site energy analyses violate these laws by ignoring the energy losses prior to the building line. An example of this policy is the electric heat pump, with an efficiency that is always portrayed as greater than 100%.

The science of thermodynamics is based on two observations of nature: (1) the energy added to a system is equal to the energy lost from the system and the energy stored by the system and (2) the work, or power, obtained from an energy process is always less than the energy added to the process. The first observation is called Conservation of Energy and is the First Law of Thermodynamics. The second observation is called the Second Law of Thermodynamics.

Using these uncompromised laws of nature, an on-site energy analysis depicts certain energy uses inaccurately. Consistency with these laws dictates the entire energy efficiency system be evaluated in combining and comparing energy use in Btu's.

As stated above, the ERDA Act requires DOE to conduct a study on "net-energy analysis" or Second Law efficiencies. This study was released last January by the National Bureau of Standards (NBS) and should form the basis for upcoming DOE decisions regarding energy conservation. In addition, Section 683 of the National Energy Conservation Policy Act (NECPA) mandates that a Second Law efficiency study be conducted by DOE and NBS, requiring specific applicability to ECPA from which the proposed BEPS are derived.

Conclusion

BEPS is the most significant step in recent years in the case of energy conservation. There are many misconceptions regarding BEPS, most of which we have tried to address in our testimony. Finally, the BEPS can provide a significant advance in the goal of energy conservation and their early implementation should be a foremost part of our national energy policy.

A.G.A. appreciates the opportunity of testifying on the BEPS. I will be pleased to answer any questions you might have.

WALL STREET JOURNAL

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ATTACHMENT 1

[illegible] THURSDAY, MAY 3, 1979

Balance of Power

Energy-Costly Energy Is Wasting Resources, Some Analysts Worry

Supply, Not Price, Is Concern Of Net-Energy Theory; Many Reject 'Novel' Idea

Is 'Zero Growth' on Its Way?

By PETER B. ROCHE

Staff Reporter of THE WALL STREET JOURNAL

Every time Dow Chemical Co. turns out a finished product, whether it be chlorine or polyethylene, it knows exactly how much it cost to make. That's usual. What is unusual is that Dow also knows precisely how much energy was consumed during production.

Periodically, a computer at Dow's Midland, Mich., headquarters is fed reports from the company's seven major divisions. Measurements of energy performance at widespread plants and in hundreds of individual manufacturing operations are distilled into a single energy balance sheet. "By the time a product leaves our gate, we know how much energy went into that product," says Dow's national conservation manager, Lawrence L. Saphier.

Dow then calculates the energy value—in British thermal units, or BTUs—of its finished products. By comparing the two figures, energy used in production, or gross energy, and the energy value of the final product, or net energy, Dow is able to tell how much energy it has consumed.

Dow's elaborate energy accounting is more important than being just a tool to help industry become more energy-efficient. It is also a highly controversial method of accounting for the energy that is consumed in the country as a whole in the production and delivery of energy. Some analysts believe that this "new energy math" will be of vital importance to the U.S. in conserving its dwindling reserves of fossil fuels.

Limits to Growth?

Net energy—or the amount of energy that actually reaches the consumer, whether it be as heating oil, gasoline or electricity—is becoming a much-discussed topic in academic circles as energy supplies get tighter. In the view of some, it could also be a limiting factor in President Carter's plans, as set out in his recent energy message, to increase U.S. oil production, to make greater use of U.S. coal reserves and to develop new energy sources, from oil shale to gasohol. The reason: The energy expenditures may, in some cases, be too great.

By some calculations, less and less of our energy reserves are reaching the consumer because more energy is going into their production. As reserves of oil, low-sulphur coal and natural gas become depleted, it becomes more difficult to replace these sources: Deeper wells must be drilled, equipment must be flown in to ever more remote sites, and elaborate delivery systems, such as the Alaska pipeline, must be built. Also, more of our energy is being delivered in the form of electricity, which means greater energy expenditures to build generating plants and to convert fuels to electricity.

A minority of energy economists and analysts are going against the tide of conventional economics by insisting that energy-wasteful technologies, whose only consideration is cost, deplete nonrenewable, high-quality energy sources. They believe that the major consideration should be conservation of these resources through net-energy analyses; these analyses would discourage energy-production technologies—from generating plants to refineries—that are in themselves large consumers of energy.

A "Novel" Appearance

To many conventional economists, all this sounds very much like asking Americans to reduce their living standards. They point out that conservation controls already are set by the marketplace because the less-efficient uses of energy decline as energy prices rise. But at the same time, advanced methods to extract hard-to-reach oil and natural gas reserves become economically feasible, releasing huge new supplies of fossil fuels. The net-energy analyst "is just trying to make himself look novel," says Paul W. MacAvoy, a Yale University economist and former economic adviser to the Ford administration.

In the days of plentiful, and cheap, energy, it was of little consequence that energy was being used in the production of energy. The only gauge was that of dollars and cents. If a project was low in monetary cost but high in energy cost, it was considered to be an economic proposition.

But with the Arab oil embargo in 1973 and the subsequent sharp increase in oil prices, energy planners started to take notice of the effects of energy losses. And in 1974, Congress passed the Non-Nuclear Energy Research and Development Act; under this law, a net-energy analysis had to be carried out on any non-nuclear project receiving research funds from the Department of Energy.

But the law has been largely ignored because there is little agreement on what should be included and what omitted as energy expenditures in the production process. "Examples of net-energy analysis can be cited where widely varying conclusions have been reached on similar energy systems," says D. W. Fraley and C. L. McDonald, energy researchers at Pacific Northwest Laboratories.

The General Accounting Office has, perhaps, been the law's biggest critic. It has issued an opinion that net-energy analysis is meaningless because, the GAO says, it doesn't provide any benefits that aren't already available from price-cost comparisons.

A critic who agrees with the GAO is David A. Huettner, associate professor and energy-department director at the University of Oklahoma's Center for Economic and Management Research. "If the price of energy is left free, it will rise and encourage conservation and alternative forms," he says. Indeed, he feels that looking only at energy gains and losses could well kill some promising energy alternatives. Some emerging technologies, he says, might appear to be too costly to develop in energy terms, but if allowed to progress, they might ultimately be profitable in both energy and dollar terms.

But Barry Sedlik, an energy analyst with Teknekron Inc., a Washington consulting firm, disputes this view. "The key problem is that economic theory doesn't come to grips with depletable resources," he says. "If the price goes up, economists say, you increase supply." But, he maintains, increasing the energy supply isn't desirable because "you are dealing with a nonrenewable commodity."

This is essentially where most economists and net-energy advocates part company. Economists generally believe that economic production is tied to energy growth, even though in recent years the gross national product has been growing faster than energy demand. But some net-energy analysts believe that the U.S. economy could continue to grow even without a year-to-year increase in energy supply.

According to Earl T. Hayes, a former chief scientist at the U.S. Bureau of Mines and now a consultant, the era of so-called zero energy growth will arrive before the end of the century. In a recent article in Science magazine, Mr. Hayes calculated that the nation's average net energy is 80% of the gross, meaning that 20% of all energy reserves are consumed in recovering and delivering energy. By the year 2000, Mr. Hayes said, the net-energy factor will be reduced to 75% as energy reserves become harder to exploit and more energy is expended in getting energy to market.

[illegible] energy growth will be brought "almost to a halt" in the 1990s. By that time, he said, the annual energy growth will be consumed both in energy production and in feeding, housing and transporting the additional population.

Trees in a Mature Forest

Mr. Smith believes that an era of zero energy growth wouldn't bring about major economic dislocations. But it would, he predicts, bring about strict conservation: Steel would replace aluminum, natural fibers would replace synthetics and trucks would give way to rail transport. It would, he says, be somewhat like trees in a mature forest, few evolving from seeds, but competing for space and now existing in a "steady state" for an indefinite period.

Economists, he asserts, have misjudged the effect that energy has on the U.S. economy because they have only calculated the price of energy. The real economic yardstick, he insists, should be energy's long-term profitability.

Most economists, who view the world through more conventional eyes, believe that net-energy theories deal in an unreal world in which an impractical idea of the future is substituted for hard reality. For a start, they say, prices and energy go hand in hand, and as prices rise, the substitution of new energy technologies becomes feasible. Economically, says Yale's Mr. Mackay, "there is no such thing" as a nonrenewable resource.

"Any approach that centers on energy resources alone, thereby refusing substitution, will end up wasting some kind of resource," he says. "There is no substitute for rising prices" because as prices increase, you get more conservation, reduce demand and then [illegible] funds for the development of new technology, Mr. Mackay declares.

[illegible] net-energy researchers are intent on [illegible] the energy inefficiencies that are built into present energy-delivery systems. [illegible] Melcher, an engineer at the Colorado School of Mines Research Institute, has made a study of delivering heat to Denver homes by two methods, both using coal. One [illegible] the conventional method of using coal to power a generating plant to produce the electricity to run home hot-water and space heaters. The other method is to build a plant [illegible] process coal and turn it into gas, which could then be delivered directly to the home.

[illegible] Electricity

Mr. Melcher found that coal gasification [illegible] be 39% more energy-efficient than coal-fired electrical generation. Despite this energy saving, and the presumed saving in [illegible], a commercial coal-gasification plant [illegible] yet been built in the U.S.

The energy losses in coal-fired generating plants are high. Just to bring a ton of coal to the mine surface takes the equivalent of 2% of the ton. More energy is consumed in moving the coal to the generating plant. But the big loss comes in converting coal to electricity—a process that consumes two-thirds of the coal's energy.

Oil is similarly depleted in production. The equivalent of 12% of a barrel of oil is consumed in drilling. At the refinery, where oil is turned into any number of products from gasoline to chemicals, the equivalent [illegible] 11% of the barrel is required for energy [illegible] larly gloomy about oil-fired generating plants because, he says, for every 1,000 BTUs of oil in the ground, we are able to produce only 280 BTUs in usable electric power.

Net-energy analysts now are beginning to look at a number of other energy sources and are calculating how much energy is used in their exploitation. They say that hydroelectric power is the most energy-efficient, followed by coal, natural gas, petroleum and nuclear energy.

This differs from the nation's energy-use patterns. Last year petroleum accounted for almost half our needs, natural gas for 26%, coal for 19%, hydroelectric power for 4% and nuclear energy for 4%. Hydroelectric power is so efficient, Mr. Melcher says, because it has no need for fuel other than renewable mechanical energy in the form of falling water. Also, he says, "there is a small energy investment for plant and equipment compared with a large power output."

The techniques used to calculate the efficiency of energy technologies vary widely. One technique might measure the energy consumed by workers getting to and from their jobs. Another might ignore the human involvement. "There still hasn't been any consistency in approaches used to evaluate different types of energy," says Mr. Smith. "The result is that the findings differ depending on the method of analysis used."

Mr. Melcher analyzes petroleum energy, for example, by calculating the amount of energy used in exploration and drilling, production, transportation and delivery. In all, between 33 and 40 different stages are given energy values.

The energy involved in building and running generating plants and refineries can be calculated in much the same way. All the materials used in building the plants are analyzed for their energy values, as are construction and maintenance.

Net-energy analysts don't consider only conventional technologies but also new ideas, some of which are still on the drawing board. An example is gasohol, or alcohol distilled from various crops and blended with gasoline. Mr. Melcher has analyzed alcohol-production methods and concludes that if the raw materials used in distillation are corn or wheat, more energy is consumed in production than is actually produced. If sugar cane is used, he says, there is a modest gain in energy. Robert A. Herendeen, a researcher at the University of Illinois, concludes that although alcohol distilled from sugar cane may be a marginal producer of net energy, it is "uncomfortably close" to being a net energy loser.

The Solar Satellite

Mr. Herendeen has found another technology that he asserts is possibly a net loser: the much-discussed solar satellite, which would produce solar energy by beaming microwaves back to earth stations. He concludes that the satellite is close to "the net-energy limit: the point at which an energy-supply technology requires more energy than it produces."

These researchers are saying, in essence, that by basing energy supplies on efficiency rather than on cost, the U.S. can extend its support of nonrenewable fossil fuels. Energy-draining technologies could "[illegible] a [illegible] to pour our high-grade . . . energy ever faster down a rat hole," says physicist Amory Lovins, the British representative of Friends of the Earth, an international environmental group.

Profligate use of fossil fuels, net-energy analysts say, is the result of the search for short-term economic gains during a period of rapid energy growth. For 20 years, they say, energy use and the real gross national product (adjusted for inflation) grew together at an annual rate of 3% to 3.5%. But in 1977, energy growth stayed level at 2% while GNP growth rose to 5%.

Mr. Smith notes that some net-energy researchers already are saying that energy consumption has leveled off in the U.S. The latest Energy Department figures show that energy consumption in the U.S. grew by only 1.6% last year, narrower than the 2.9% in 1977 and the 5.3% in 1976. "Some people would argue that 1.6% growth is almost a steady state compared with the growth in the past two decades," he says.

ENERGY ANALYSIS

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1979-3 January 26, 1979

COMPARISON OF A BALANCED RESIDENTIAL/COMMERCIAL ENERGY ECONOMY VERSUS AN ALL ELECTRIC RESIDENTIAL/COMMERCIAL ECONOMY

A. Introduction

The choice of natural gas versus electricity for use in meeting residential and commercial energy needs is a topic of extensive national debate. The principal concern is to assure the wise use of the nation's energy resources, including maximum energy efficiency, least cost to the Nation's consumers as well as the overall economy, and the most acceptable environmental consequences.

The purpose of this analysis is to compare two alternative energy use scenarios for the residential and commercial (R/C) sectors.

- An All Electric Scenario which assumes that all future installations of R/C space conditioning systems and appliances will be electric.
- A Balanced Energy Scenario which assumes that gas will be used in all future installations of R/C systems and appliances for space and water heating, cooking and drying, with electricity being used for all other R/C installations.

B. Executive Summary of Results

The results of this analysis indicate that the balanced energy scenario offers significant benefits to both the nation and the individual consumer when compared with the all electric scenario.

From the consumers' viewpoint, the greater use of gas systems and appliances as in the balanced energy scenario would be the least expensive equipment configuration on an average U.S. life cycle cost basis (i.e., including annualized purchase and installation, fuel, and maintenance expenses).

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From the nation's viewpoint, the greater use of gas systems and appliances would result in a stronger economy, the most efficient use of energy resources, and only a fraction of the pollution compared to an all electric scenario.

- The inflationary effect of an all electric scenario would result in lower real gross national product of $7.9 billion in 1985 and $7.3 billion in 2000 (1978 dollars) when compared to the balanced energy scenario. Moreover, in the year 2000, U.S. net foreign payments would be $4.5 billion greater in the all electric scenario as a result of increased oil imports for new and existing electric power plants and reduced exports that would result from higher prices for U.S. made goods.

- On average, the annual life cycle cost to the consumer of space conditioning and appliances in an all electric home would be 51% or $679 higher in 1985 and 70% or $947 higher in the year 2000 (1978 dollars) than the costs for a balanced energy home.

    - The major cost element, annual fuel costs, would be 98% higher for the all electric home in 1985 ($1,142 vs. $577) and 167% ($1,439 vs. $539) higher in 2000 compared to fuel costs of a balanced energy home.

- Over the total fuel cycle, the use of natural gas space conditioning systems and appliances would be more than twice as energy efficient as the delivery and utilization of electricity. The total cycle includes extraction, transport and processing of fuel, electricity generation, transmission, distribution and end-use, each weighted by market share.

- Over the total fuel cycle, the balanced energy scenario would produce significantly smaller quantities of environmental pollutants than the alternative all electric scenario. For example, in 2000 the latter scenario would result in a more than ten-fold increase of both air pollutants and solid wastes compared to the balanced energy scenario.

C. Scenario Description

The two market share scenarios were defined as follows:

- Balanced Energy Scenario -- Existing homes and appliances were assumed to continue using their present forms of energy, i.e., electricity, oil, or natural gas. All future R/C installations including replacements of obsolete and malfunctioning units were assumed to use gas to the extent possible for those applications to which it is best suited, i.e., space and water heating, cooking and clothes drying. Electricity was assumed to meet the major share of air conditioning needs (Table 1). Fuel oil is assumed to maintain a constant market share throughout the period.

- All Electric Scenario -- Existing homes and appliances were assumed to continue using their present energy forms. All future installations and replacements of R/C space conditioning systems and appliances were assumed to be electric (Table 1).

Each scenario was simulated using the Total Energy Resource Analysis (TERA) Model to determine gas sales volumes and associated retail prices.[1] Gas pricing in both scenarios was determined according to provisions of the Natural Gas Policy Act of 1978, including Rule I incremental pricing. Large boiler users (over 300 Mcf per day) of natural gas, under Rule I provisions, were assumed to be subject to gas price increases until gas reaches the price of alternative fuel (No. 2 or No. 6 oil depending on the region). Burner-tip prices to and consumption by the industrial and electric utility sectors were assumed constant between scenarios.

D. Macroeconomic Impacts

Macroeconomic impacts of the balanced energy scenario and the all electric scenario are compared in this section.

D.1. Macroeconomic Impacts Methodology

Volume and price data from TERA were used as inputs to the Wharton Econometric Forecasting Associates (WEFA) Annual Energy Model for assessing macroeconomic impacts during the 1981-1989 period[2] (Table 2).

Economic data for 2000 were projected by extrapolation of 1981 to 1989 WEFA forecasts and adjusted for the relative magnitude of changes in gas and electric consumption, prices and investment in the 1990-2000 period versus the 1981-1989 period.

---

[1] Total Energy Resource Analysis (TERA) Model developed and maintained by A.G.A., (November 1978 output).

[2] For information about the WEFA Annual Energy Model contact Wharton Econometric Forecasting Associates, 3624 Science Center, Philadelphia, PA 19104, (215) 386-9000.

TABLE 1

FUEL REQUIREMENTS AND MARKET PENETRATION ASSUMPTIONS OF END-USE DEVICES
(% share for new gas or electric devices in residential applications)

Space Conditioning

	GAS MARKET				ELECTRIC MARKET	
	Conventional Gas Furnace/ Air Conditioner	Improved Conventional Gas Furnace/ Air Conditioner	High Efficiency Gas Furnace/ Air Conditioner	Gas Heat Pump	Electric Resistance/ Electric Air Conditioner[1]	Electric Heat Pump
Annual Fuel Requirements (MMBtu)	106.9	85.5	77.5	55.3	68.7	41.23[2]
1978 - 1980(%)	90	10	0	0	50	50
1980 - 1985(%)	66	30	3	1	50	50
1985 - 2000(%)	4	26	48	22	50	50

Appliances

	GAS MARKET					ELECTRIC MARKET		
	Standard Water Heater	Improved Water Heater	Standard Cooking Range	Improved Cooking Range	Gas Dryer	Water Heater	Dryer	Cooking Range
Annual Fuel Requirements (MMBtu)	31.4	24.3	10.2	7.1	5.0	22.4	4.3	5.4
1978 - 1980(%)	70	30	80	20	100	100	100	100
1980 - 1985(%)	25	75	25	75	100	100	100	100
1985 - 2000(%)	0	100	10	90	100	100	100	100

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[1] It is assumed that heat pumps will maintain a constant rather than growing share of market because of first cost considerations, air conditioning cycle inefficiencies, reduced heat losses in new houses and a lower degree of comfort offered by those systems.

[2] The fuel requirement would drop to 35.16 MMBtu by 1990 due to efficiency improvement.

Source: Marketing Services Division, American Gas Association.

TABLE 2

DELIVERED GAS VOLUMES AND PRICES TO THE RESIDENTIAL AND COMMERCIAL SECTORS

	1980	1985		2000	
		Balanced Energy Economy	All Electric Economy 1/	Balanced Energy Economy	All Electric Economy 1/
Volumes (Quads)					
Residential	4.9	5.8	3.8	7.1	1.3
Commercial	2.7	3.0	1.8	3.5	0.6
Burner Tip Prices (Current $/MMBtu)					
Residential	2.94	4.39	5.02	10.65	19.54
Commercial	2.62	4.12	4.23	10.22	12.84

1/ Gas volumes and prices in the all electric scenario are for existing gas systems and appliances that are not replaced during the forecast period.

Source: Total Energy Resource Analysis (TERA) Model runs of November 1978.

Three major assumptions were essential to scenario simulation with the WEFA Model:

- The personal savings rate, representing the proportion of disposable personal income that is saved, was assumed identical under both scenarios.
- The change in commercial sector energy input costs was assumed to be passed on to the consumer.
- Each dollar of investment associated with natural gas production and delivery was assumed to have similar macroeconomic impacts as a dollar of electric utility investment, although the sectoral distribution of this income may differ slightly.

D.2. Macroeconomic Impact Results

Under these assumptions, the balanced energy scenario would result in a stronger economy than the all electric scenario. Real gross national product in the balanced energy scenario would be $7.9 and $7.3 billion (1978 dollars) higher in 1985 and 2000, respectively, primarily due to lower inflation (Table 3). Unemployment would be 0.3 to 0.4 percent lower during the forecast period, and the current account surplus in the nation's balance of payments would be almost double that of the all electric scenario ($10.4 billion versus $5.9 billion in 2000). Moreover, the higher total cycle efficiency of natural gas would result in a 1.1 percent reduction of energy consumption per dollar of GNP by 2000.

While the differences in macroeconomic impacts between the two scenarios are significant, they are smaller than one might intuitively expect. This is due to two major offsetting factors.

First, the electric utility sector is more capital intensive than natural gas; that is, given equal increases in natural gas and electricity consumption more capital investment would be required in the electric utility sector to generate this additional output.[3/] By 2000, an additional $30 billion of real investment is required in the all electric scenario. It was assumed that on balance, this investment would have a positive impact on the economy.

[3/] For analysis of capital requirements derived from a wide variety of public data see: A Comparison of Capital Investment Requirements for Alternative Domestic Energy Supplies (Arlington, VA, American Gas Association, May 18, 1978), and the LNG Fact Book (Arlington, VA, American Gas Association, December 1977), p. 13.

TABLE 3

PROJECTED MACROECONOMIC IMPACTS OF A BALANCED ENERGY ECONOMY VERSUS AN ALL ELECTRIC ECONOMY

(billions of 1978 dollars except as shown)

	1980	1985		2000	
		Balanced Energy Economy	All Electric Economy	Balanced Energy Economy	All Electric Economy
Gross National Product	2,324.3	2,748.8	2,706.2	4,188.2	-4,180.9
GNP Price Deflator (1972=100)	178.4	241.7	242.7	488.6	490.5
Consumer Expenditures on Natural Gas	9.3	10.9	7.0	-	-
Price Deflator-Natural Gas Consumption Expenditures (1972=100)	246.9	371.8	418.9	-	-
Ratio-Energy Consumption to GNP (Thousands of Btu/dollar of GNP)	54.8	50.6	51.4	45.5	46.6
Gross Private Domestic Investment	318.0	400.0	398.4		
Manufacturing Output	564.6	676.7	672.8	-	-
Corporate Profits	213.3	245.9	235.0	499.6	485.0
Balance of Payments-Current Account	-2.2	13.1	8.2	10.4	5.9
Disposable Personal Income	1,656.3	1,913.2	1,909.0	-	-
Unemployment Rate (%)	5.4	4.6	5.0	3.2	3.5

Source (1980, 1985): Annual Energy Model (Philadelphia, PA., Wharton Econometric Forecasting Associates, Inc., June of November 1979).

(2000): A.G.A. projections based on changes in gas and electric consumption, prices and investment as derived from the TERA model.

Note: All dollar values, except corporate profits and balance of payments were converted from 1972 dollars to 1978 dollars, using the GNP price deflator. Corporate profits and balance of payments, originally expressed in current dollars, were deflated to 1978 dollars using the appropriate forecast value of the GNP deflator.

Second, there is a strong price effect which counteracts the impact of the additional investment. In the all electric case, homeowners must spend a considerably larger percentage of their income on utility bills. Moreover, since the commercial sector is assumed to pass on its increased fuel costs, the consumer must pay a higher price for the goods and services and, therefore, will likely consume lesser quantities. As a result, investment would decline in response to the decreased demand.[4]

The converse is true in the balanced energy scenario, where the favorable price effect outweighs the negative impact of lower utility investment. Since less capital is required to produce a Btu of energy from gas than from electricity, investment in this utility sector will be lower in the balanced energy scenario. However, homeowners' utility bills are reduced, enabling them to spend more of their income on goods and services. This positive effect is enhanced by lower prices in the commercial sector, resulting from the assumed pass-through of fuel cost savings. Investment in sectors other than utilities will thus increase resulting, on balance, in favorable macroeconomic conditions.

It should be noted that the balanced energy scenario would likely produce greater macroeconomic benefits than are shown in Table 3. Existing macroeconomic models do not adequately capture the impact of the capital efficiency of gas. The lower capital requirements result in less money being diverted to production of energy, an input into the production process, thus freeing funds for production of final goods for domestic consumption and export.

E. Cost to Consumers

This section compares the cost of installing, maintaining and operating space conditioning devices and appliances in a balanced energy home and in an all electric home.

E.1. Cost to Consumer Methodology

It was assumed that new homes, replacement purchases and conversions of space conditioning equipment and appliances would utilize gas or electricity according to the balanced energy or all electric scenario assumptions.

The cost of a balanced energy and all electric home was calculated by multiplying installation, operation and fuel costs of space conditioning equipment and appliances by the share of their respective growth markets. These individual costs were then summed for the total consumer costs of a balanced energy and all electric home in 1980, 1985 and 2000.

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[4] It should be noted that these effects are not continuous. In the late 1980's, the investment effect slightly outweighs the price effect, since some capital investment plans are well underway before the full magnitude of consumption decline become apparent.

Individual costs components are as follows:

- Purchase, installation, operation and maintenance costs for the conventional gas furnace, electric air conditioner and electric heat pump were derived from city cost information in Heat Pump Technology (Washington, D.C., Gordian Associates for the U.S. Department of Energy, June 1978). These installed costs were averaged nationally by weighting according to residential market share information reported in Gas Facts: 1977 (Arlington, VA, American Gas Association, October 1978), and in the EEI Statistical Yearbook: 1977 (New York, New York, Edison Electric Institute, October 1978). The costs for the improved and high efficiency gas furnaces and gas heat pump were A.G.A. estimates. Operation and maintenance costs were assumed in Heat Pump Technology to be the same in all cities.
    - Installed space conditioning equipment costs (component prices, labor, contractors' fees, state and local taxes and freight costs) were annualized according to standard life cycle cost assumptions.[5]
- Installation, operation and maintenance costs for appliances: i.e., water heaters, dryers, and ranges were based on current Montgomery Ward's information[6] and Marketing Services Division of the American Gas Association information, respectively. Installed equipment costs which include component prices, installation costs, and state and local taxes were annualized according to standard life cycle cost assumptions.[5]
- Annual fuel costs were derived by multiplying the residential gas and electricity prices shown in Table 4 by the fuel requirement of each unit from Table 1.

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[5] Depreciation periods were assumed according to the Handbook and Product Directory, (New York, NY, ASHRAE, 1975), Internal Revenue Service standards, and dealer estimates: Electric air conditioner - 10 years; electric heat pump and gas heat pump - 9 years; gas furnace (all types) - 16 years; water heater, dryer, and range - 10 years. A 9% interest rate was applied to the equipment life assumptions to arrive at the capital recovery factor for all devices except the dryer. 18% interest rate was applied to the dryer.

[6] Spring and Summer Catalog (Chicago, Illinois, Montgomery Ward, Inc., Spring, 1978).

Table 4

RESIDENTIAL FUEL PRICES
(1978 $/MMBtu)

	Gas[1/]	Electric[2/]
1980	$2.64	$12.12
1985	3.02	13.11
1990	3.28	16.71

1/ Gas prices were derived from current dollar Balanced Energy residential prices in Table 2 assuming a 5.5% annual inflation rate.

2/ Electric prices were derived from current dollar All Electric residential prices assuming a 5.5% annual inflation rate.

E.2. Cost to Consumer Results

The life cycle cost of installing, operating and maintaining space conditioning equipment and appliances in an all electric home would be 50% or $635 higher in 1980, 51% or $679 higher in 1985 and 70% or $947 higher in 2000 than the costs for a balanced energy home (Table 5). Fuel costs for the all electric home would be 91% higher in 1980, 98% higher in 1985 and 167% higher in 2000 than for the balanced energy home.

From 1980 to 2000, the annual life cycle cost to the consumer of buying, maintaining and operating space conditioning equipment and appliances in a balanced energy home would increase by 5.5% or $71. Comparative costs in an all electric home would increase by 20.0% or $383. In the cost component detail of Table 4, it can be seen that the higher rate of increase in electric costs is due solely to rising fuel costs. Constant 1978 dollar purchase, installation and operation costs for the all electric residence remain the same during the 1980 to 2000 period because of the constant market penetration assumptions of Table 1.

Annual life cycle installation and operation costs for space conditioning a balanced energy home would rise 6.0% or $49 from 1980 to 2000. All electric space conditioning cost would rise by 19.7% or $236 over the same time period. The entire $236 increase is due to higher fuel costs. Effective gas fuel cost would drop by 4.3% or $19 per year (Table 5-A) due to improved efficiency of gas space conditioning equipment. It would appear from the table that the rising electric fuel

TABLE 5

ESTIMATED AVERAGE PROJECTED U.S. ANNUAL SPACE CONDITIONING AND APPLIANCE COST FOR NEW "BALANCED ENERGY" AND "ALL ELECTRIC" HOMES 1/, 2/

(1978 $)

	1980		1985		2000	
	Balanced Energy	All Electric	Balanced Energy	All Electric	Balanced Energy	All Electric
Annualized Capital Cost (Installed) 3/, 4/	$ 463	$ 571	$ 481	$ 571	$ 537	$ 571
Operation & Maintenance	264	288	264	288	275	288
Fuel						
Gas	356	0	367	0	327	0
Electric	197	1056	210	1142	212	1439
TOTAL	1280	1915	1322	2001	1351	2298

Sources: Space Conditioning Devices Capital and Operation Costs: Heat Pump Technology (Washington, D.C., Gordian Associates Inc., for the U.S. Department of Energy, June 1978).

Non-Space Conditioning Capital Costs: Spring and Summer Catalog (Montgomery Ward, Spring, 1978).

Non-Space Conditioning Operating Cost Assumption: Marketing Division of American Gas Association.

Fuel Price Estimates: Total Energy Resource Analysis (TERA) Model (Arlington, VA, American Gas Association, November, 1978).

1/ Table 5 is the sum of Tables 5-A and 5-B.

2/ National average costs for space conditioning were derived from city information by weighting according to regional residential market shares presented in Gas Facts: 1977 (Arlington, VA, American Gas Association, October 1978) and in Statistical Year Book (New York, NY, Edison Institute, October, 1978) Escalated to 1978 dollars according to Consumer Price Index Information.

3/ Installation cost estimates include component price, labor, contractor's fee, state and local taxes and freight cost for space conditioning devices (gas furnace, electric air conditioner, gas heat pump, and electric heat pump), water heater, dryer, and range. Ductwork not included.

4/ Depreciation periods for space conditioning devices and appliances on the basis of the Handbook and Product Directory, (New York, New York, ASHRAE, 1975), Internal Revenue Service standards and dealer estimates: Electric air conditioner - 10 years; electric heat pump and gas heat pump - 9 years; and gas furnace (all types) - 16 years. Depreciation period for water heater, dryer, and range (gas and electric) was assumed to be 10 years. A 9% time value of money was applied to the equipment life assumptions to arrive at the capital recovery factor (discounted cash flow basis) for all devices except dryer. 18% interest was applied to the dryer costs.

TABLE 5-A

ESTIMATED AVERAGE PROJECTED U.S. ANNUAL COSTS OF SPACE CONDITIONING FOR NEW "BALANCED ENERGY" AND "ALL ELECTRIC" HOMES[1,2]

(1978 $)

	1980		1985		2000	
	Balanced Energy	All Electric	Balanced Energy	All Electric	Balanced Energy	All Electric
Annualized Capital Cost (Installed)	$ 262	$ 393	$ 268	$ 393	$ 319	$ 393
Operation & Maintenance	114	138	114	138	125	138
Fuel						
Gas	240	0	250	0	206	0
Electric	197	667	210	721	212	903
TOTAL	813	1,198	842	1,252	862	1,434

1. Assumptions and sources listed in Table 5.

2. Table 5 is the sum of Tables 5-A and 5-B.

TABLE 5-B

ESTIMATED AVERAGE PROJECTED U.S. ANNUAL COSTS OF APPLIANCES (WATER HEATER, DRYER, RANGE), FOR NEW "BALANCED ENERGY" AND "ALL ELECTRIC" HOMES[1,2]

(1978 $)

	1980		1985		2000	
	Balanced Energy	All Electric	Balanced Energy	All Electric	Balanced Energy	All Electric
Annualized Capital Cost (Installed)	$ 201	$ 178	$ 212	$ 178	$ 218	$ 178
Operation & Maintenance	150	150	150	150	150	150
Fuel						
Gas	116	0	117	0	121	0
Electric	0	389	0	421	0	536
TOTAL	466	717	479	749	489	864

1. Assumptions and sources listed in Table

2. Table 5 is the sum of Tables 5-A and 5-B.

costs in the all electric residence are inconsistent with lower fuel costs for the electric air conditioner in a balanced energy home. However, the decline in electric air conditioning fuel costs is not the result of a decline in electricity cost but reflects the greater market penetration of gas heat pumps and an attendant reduction in electric air conditioning usage.

F. Efficiency Comparison

This section compares the energy efficiencies associated with the balanced energy and all electric scenarios. The comparison quantifies losses which can be expected in the delivery and utilization of gas and electricity in residences.

F.1. Efficiency Comparison Methodology

Energy delivery losses in the development of energy resources from the point of extraction through delivery to the residence, are detailed in Tables 6-A and 6-B. The mix of expected sources of natural gas and electricity were obtained from the TERA Model and from the most recent Federal Energy Regulatory Commission forecast of power plant additions.

For efficiency losses in the residence, space conditioning efficiency data (Table 6-C) from Heat Pump Technology was averaged nationally by weighting according to Gas Facts and EEI Statistical Yearbook market share information. HEED (Arlington, VA, American Gas Association) space conditioning and appliance efficiencies in Table 6-C were assumed to represent national efficiencies. All space conditioning equipment and appliances were assumed to be utilized according to the market penetration asumptions (Table 1).

Combination efficiencies (Table 6-C) were derived by multiplying the efficiency of gas and electric units by their proportion of the total space conditioning fuel requirement. The proportions of total space conditioning in Table 6-D represent national averages. The conventional gas furnace/electric air conditioner and electric resistance/air conditioning national average heating-cooling ratios were derived from market share data in Gas Facts: 1977 and the EEI Statistical Yearbook: 1977 respectively. The improved conventional and high efficiency furnace ratios were derived by subtracting the electric air conditioning fuel requirement from the total space conditioning fuel requirement in the Appendix. The derivation of combination efficiency is illustrated by the following formula:

Combination efficiency = Σ (% of total annual space conditioning requirement of Table 6-D) x (unit efficiency of Table 6-C).

e.g., for conventional gas furnace and electric air conditioning combination efficiency = (84.8%) (.65) + (15.2%) (1.85) = 83%

TABLE 6 - A

EFFICIENCY OF ENERGY DELIVERY TO RESIDENCE: NATURAL GAS1/
(% of original energy retained)

	Onshore - Offshore	Coal Gas
Extraction	99.6	99.2
Transport to Processing	100.0	100.0
Processing	96.7	92.0
Gasification	Does Not Apply	59.0 2/
Distribution	92.2	92.2
Total Delivery Efficiency	88.7	49.6

Average 88.4

1/ For the balanced energy scenario new natural gas consumption was assumed to be 99.1% conventional gas and 0.9% coal gas as projected by the TERA Model. Distribution efficiency losses include long distance pipeline transmission losses.

2/ Represents Lurgi pilot plant efficiency.

Sources: Energy and the Environment (Washington, D.C. Council on Environmental Quality, August, 1975).

TABLE 4-4

EFFICIENCY OF ENERGY EXTRACTION, PROCESSING AND DELIVERY TO A RESIDENCE: ELECTRICITY[1]
(% of original energy retained)

	Oil	Natural Gas	Combined Cycle	Coal Far From End-Users	Coal Near End-Users	Nuclear	Hydro	Fuel Cell
Extraction	99.6	99.8	99.2	99.2	99.2	99.6	100.0[3]	99.2
Transport to Processing	98.1	100.0	100.0	100.0	100.0	100.0	100.0[3]	100.0
Processing	93.9[2]	96.7	92.0	92.0	92.0	97.8	100.0[3]	92.0
Transport to Electric Generation	98.1	99.0	98.0	100.0	98.	100.0	100.0[3]	100.0
Electric Generation	35.0	38.0[2]	38.0[4]	33.4	33.1	33.0	100.0[3]	40.0[5]
Distribution	91.2	91.2	91.2	[illegible]	91.2	91.2	91.2	91.2
Total Delivery Efficiency	31.8	31.7	31.1	29.6	28.2	18.2	91.2	33.3

Weighted average 26.2

Assumptions:

Electrical generation efficiency weighted by information in Proposed Generating Capacity Additions 1977-1986 (Washington, D.C., Federal Power Commission, September, 1977) as follows:

Coal	Share (%)
Fossil Steam	46.3(%)
Combined Cycle	2.2
Fuel Cells	0.1
Oil and Gas	
Combustion Turbines and Diesel	3.6
Nuclear	
Light Water Reactor	41.5
Other	
Hydro and Pumped Storage	6.5

Coal for electricity generated far from end-users is assumed to be transported by rail to electric generation plants.

Nuclear fuel is assumed to be transported to electric generation stations in special trucks.

50% of coal based electricity is generated far from end-users, 50% generated near end-users. Distribution of coal based electricity generated far from end-users includes efficiency losses for long distance transmission.

Since the efficiency of hydro generation is not available, it is assumed to be 100%. Fuel cell assumed to be coal based.

Sources:
[1] All data from Energy and the Environment (Washington, DC, Council on Environmental Quality, August, 1973) unless noted.
[2] Environmental Impacts, Efficiency, and Cost of Energy Supply and End-Use, Volume I, (Columbia, Maryland, Hittman Associates, January, 1975).
[3] Assumed to be 100%.
[4] Coal Utilization for Producing Synthetic Natural Gas vs. Electricity (draft), (Palo Alto, CA., Electric Power Research Institute, January, 1978).
[5] Based on latest Department of Energy prototype tests.

TABLE 6 - C

END USE EFFICIENCIES OF EQUIPMENT AND APPLIANCES[1], [4]
(% of original energy retained)

Space Conditioning	
Gas	
Conventional Gas Furnace	65
Improved Conventional Gas Furnace	78
High Efficiency Gas Furnace	90
Gas Heat Pump	130
Electric	
Electric Air Conditioner	185[2]
Electric Resistance Heater	99[2]
Electric Heat Pump	
Pre-1990	184[3]
Post-1990	200
Combination	
Electric Resistance Heat/Air Conditioning	127
Conventional Gas Furnace/Elect. Air Cond.	83[3]
Improved Conventional Gas Furnace/Elect. Air Cond.	98[3]
High Efficiency Gas Furnace/Elect. Air Cond.	110[3]
Water Heating, Cooking, and Drying	
Gas	
Standard Gas Water Heater	65
Improved Gas Water Heater	75
Standard Gas Range	40
Pilotless Gas Range	60
Gas Dryer	75
Electric	
Electric Water Heater	91
Electric Range	75
Electric Dryer	65

Sources and Assumptions:

[1] HEED Bulletins (Arlington, VA., American Gas Association) unless noted.

[2] Heat Pump Technology (Washington, DC, Gordian Associates for U.S. Department of Energy, June, 1978)

[3] A national average efficiency based on city information in Heat Pump Technology and weighted according to market share information in Statistical Yearbook (New York, New York, Edison Electric Institute, October, 1978).

[4] Efficiencies were weighted according to city heating-cooling ratios in Heat Pump Technology. National average efficiency was weighted according to residential market share information in Gas Facts: 1977 (Arlington, Virginia, American Gas Association, October, 1978) and Statistical Year Book (New York, New York, Edison Electric Institute, October, 1978).

TABLE 6-D

NATIONAL AVERAGE HEATING-COOLING RATIOS FOR COMBINATION SYSTEMS
(% of total space conditioning)

Conventional Gas Furnace	84.8
Electric Air Conditioner	15.2
Improved Conventional Gas Furnace	81.0
Electric Air Conditioner	19.0
High Efficiency Gas Furnace	79.0
Electric Air Conditioner	21.0
Electric Resistance	82.8
Electric Air Conditioner	17.2

Sources:

Heat Pump Technology (Washington, D.C., Gordian Associates, Inc., for U.S. Department of Energy, June, 1978).

Marketing Division of American Gas Association.

Gas Facts: 1977 (Arlington, VA, American Gas Association, October, 1978).

Statistical Year Book (New York, NY, Edison Electric Institute, October, 1978).

F.2. Efficiency Comparison Results

The analysis indicates that the balanced energy scenario with natural gas is significantly more energy efficient than the comparative all electric scenario. Over the forecast period, total cycle efficiency (includes all space conditioning and appliances) in a balanced energy home is over twice that of the all electric residence (Table 7).

Space conditioning with gas furnaces and electric air conditioning or gas heat pumps would result in total energy cycle efficiency improvements of 84.5% to 131% in the balanced energy home when compared with the all electric home.

Gas appliances are 97.5% to 289.0% more energy efficient on a total cycle basis than electric appliances. This is partially due to the introduction of more advanced gas water heaters, ranges/ovens and clothes dryers between 1980 and 2000.

G. Environmental Impacts

This section compares the environmental impact of increasing gas usage compared to increasing electric usage. The pollutants of the entire fuel cycle are assessed from the point of extraction through end-usage.

G.1. Environmental Impacts Methodology

Based on information in Environmental Impacts, Efficiency, and Cost of Energy Supply and End Use (Columbia, Maryland, Hittman Associates, January, 1975) and A Western Regional Energy Development Study (Austin, Texas, Radian Corporation, August, 1975) pollution impacts were quantified for water pollutants, air pollutants, solid wastes (exclusive of radioactive wastes) and water requirements. All the data in these volumes were adjusted to reflect efficiency losses throughout the fuel cycle so that the pollutants at all steps of the energy cycle could be expressed per Btu utilized by the end-users.

For the balanced energy scenario new natural gas consumption was assumed to be 99.1% conventional gas and 0.9% coal gas as projected by the TERA model. For the electric portion of the balanced energy scenario and for the all electric scenario, pollutants of coal, oil, gas, nuclear and hydro-generated electricity were quantified through end-usage according to the same proportions projected in Proposed Generating Capacity Additions 1977-1986 used in the Efficiency Comparison Section.

Since electricity provides 10.9% (1980), 11.7% 1985) and 11.3% (2000) of total household energy in the balanced energy scenario, electric cycle pollutants were combined with natural gas cycle pollutants.

TABLE 7

TOTAL CYCLE EFFICIENCIES OF NATURAL GAS AND ELECTRICITY PRODUCTION DELIVERY AND UTILIZATION IN A BALANCED ENERGY HOME AND AN ALL ELECTRIC HOME[1/]

	1980	1985	2000
All Space Conditioning And Appliances			
Balanced Energy	69.2	72.1	85.0
All Electric	32.8	32.8	33.0
Space Conditioning			
Gas/Electric	75.1	78.9	97.4
Electric	40.7	40.7	42.2
Water Heating			
Gas	60.0	64.0	66.3
Electric	23.8	23.8	23.8
Cooking			
Gas	38.9	48.6	51.2
Electric	19.7	19.7	19.7
Drying			
Gas	66.2	66.2	66.2
Electric	17.0	17.0	17.0

[1/] Total cycle efficiences are the product of delivery efficiencies (Tables 6-A and 6-B) and utilization efficiencies (Table 6-C) proportioned by market share assumptions in Table 1.

Sources: Energy and the Environment (Washington, D.C., Council on Environmental Quality, August, 1975).

Environmental Impacts Efficiency and Cost of Energy Supply and End-Use, Volume I, (Columbia, Maryland, Hittman Associates, January, 1975.

Heat Pump Technology (Washington, D.C., Gordian Associates for U.S. Department of Energy, June, 1979).

Heed Bulletins (Arlington, VA, American Gas Association)

G.2. Environmental Impacts Results

The balanced energy scenario would yield negligible water pollutants, 4.6 million tons of solid wastes, and in the year 2000 requires 5.3 million gallons of water per end-use quad (Table 8). By comparison, the all electric scenario would yield over 70 thousand tons of water pollutants, over 52 million tons of solid wastes and require 143 million gallons of water per end-use quad. Equally important, the all electric scenario would yield approximately 6 times more air pollutants than the balanced energy scenario.

Sulfur oxide (SO_x) pollutants would range from 14 times higher in 1980 to 8 times higher in 2000. Particulates are 7 times higher between 1980 to 2000. Nitrogen oxide (NO_x) pollutants range between 4 and 5 times higher between 1980 and 2000, Carbon monoxide (CO) pollutants range between two times and 1.5 times higher between 1980 and 2000. Aldehydes would be lower in the all electric scenario compared to the balanced energy scenario. The increase in SOx and CO pollutants in the balanced energy scenario from 1980 to 2000 can be explained by the utilization of coal gas after 1990. Aldehyde emissions would be higher in the balanced energy case due to cooking range emissions in the home.

TABLE 8

SUMMARY ENVIRONMENTAL COMPARISON OF TOTAL CYCLE POLLUTANTS IN NATURAL GAS AND ELECTRICITY PRODUCTION, DELIVERY AND UTILIZATION IN BALANCED ENERGY AND ALL ELECTRIC HOMES

	1980		1985		2000	
	Balanced Energy	All Electric	Balanced Energy	All Electric	Balanced Energy	All Electric
Water Pollutants (thousands of tons/end-use quad)						
Acids	<1	6.6	<1	6.6	<1	6.6
Solids	4.9	67.0	5.3	67.0	5.1	67.0
Organics	<1	0.0	<1	0.0	<1	0.0
Air Pollutants (thousands of tons/end-use quad)						
Particulates	27.1	216.5	27.6	216.5	27.6	216.5
NOx	99.5	507.5	99.2	507.5	89.8	507.5
SOx	21.5	298.9	23.1	298.9	32.5	298.9
CO	12.9	29.3	12.8	29.3	17.2	29.3
Aldehydes	5.5	<1.0	5.3	<1.0	5.0	<1.0
Solid Wastes (thousands of tons/end-use quad)	4,028.0	54,666.6	4,323.0	54,666.6	4,630.3	52,564.0
Water Requirements (millions of gallons/end-use quad)	5.0	148.7	5.4	148.7	5.3	148.7

Sources: Environmental Impacts Efficiency and Cost of Energy Supply and End Use, Volume I (Columbia, Maryland, Hittman Associates, January, 1975); and A Western Regional Energy Development Study (Austin, Texas, Radian Corporation, August 1975).

ASSUMPTIONS TO TABLE 8

Balanced Energy Scenario

1. Total cycle pollutants assessed include the following steps for each natural gas source: Offshore and Onshore Gas: onshore and offshore extraction, gathering, processing, pipeline transport, residential/commercial end-use (heating, water heating, dryer and range). Coal Gasification: extraction (50% surface, 50% deep), transport to processing, processing, transport to gasification, high-Btu Lurgi gasification, transmission, distribution, residential/commercial end-use (heating, water heating, dryer and range). Cycle pollutants for the electric air conditioning portion of the balanced energy home follow the all electric scenario methodology.

2. Environmental pollutants for natural gas delivery and end-use were adjusted to reflect the efficiency losses presented in the efficiencies section. Average household efficiency 89.7% (1980), 93.4% (1985), and 106.2% (2000) includes electric air conditioning as well as all gas heating equipment and appliances

All Electric Scenario

1. Environmental impacts assume utilization of best available control technology including, for the coal electric cycle; neutralization of acid drainage, use of scrubbers, wet cooling towers.

2. Electricity cycle assumes that growth in electric capacity will utilize the following power sources according to their respective ratios:

Coal	Share (%)
Fossil Steam	46.1
Combined Cycle	2.2
Fuel Cells	0.1
Oil and Gas	
Combustion Turbines and Diesel	3.6
Nuclear	
Light Water Reactor	41.5
Other	
Hydro and Pumped Storage	6.5

Source: Proposed Generating Capacity Additions 1977-1986 (Washington, D.C., Federal Power Commission, September, 1977)

3. Total cycle pollutants assessed include the following steps for each power source: Coal Electric: extraction (50% surface, 50% deep), transport to processing, processing, transport to electric generation, electric generation, distribution, and end-use. Oil and Gas Electric: extraction, transport to refinery or processing, refinery or processing, transport to electric generation, electric generation, distribution, and end-use. Nuclear Electric: mining, rail transport to mill, milling, rail transport to conversion, conversion, rail transport to enrichment, rail transport from power plant to reprocessing, reprocessing rail transport from reprocessing to enrichment, enrichment, rail transport to fuel lab, fuel lab, electricity transmission, end-use (heating and non-heating). Hydro-Electric: hydro-generation, extra high voltage distribution, end-use.

4. Environmental pollutants for delivery and utilization of electricity for residential space heating and non-heating have been adjusted to reflect efficiency losses in the Efficiencies Section.

American Gas Association

ISSUE PAPER ON
DOE'S PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS

The Department of Energy (DOE) is in the process of developing Building Energy Performance Standards (BEPS) for new buildings. Since the publication of the proposed BEPS (November 28, 1978), there has been a substantial amount of controversy focusing on several key aspects of the BEPS. The following dialogue presents the position of the natural gas industry on the major criticisms which have surfaced regarding the BEPS.

NATIONAL ENERGY POLICY ISSUES

- Criticism: The national energy policy disfavors oil and gas imports. The BEPS will encourage oil and gas imports and thus are contrary to national energy policy.
- A.G.A. Position: In response, A.G.A. stresses initially that the national energy policy does not disfavor gas imports. Currently, natural gas is being imported from both Canada and Mexico through pipelines and in the form of natural gas liquids. Moreover, the BEPS will reduce oil and gas imports by reducing total natural energy consumption.

  Another implication of this criticism is that the BEPS dictates an energy system fuel choice. By definition, a performance standard selects or establishes a goal to be accomplished. They do not prescribe the method by which that goal is to be accomplished. In the case of BEPS, a maximum design energy consumption level is the performance standard. The means by which that standard is met are left to the building designer. The BEPS will result in reduced energy consumption and lower consumer costs without dictating the fuel choice or the energy system to be employed in obtaining the goal.

- Criticism: By encouraging the use of natural gas, the BEPS have not accounted for energy resource availability. Nautral gas is simply not available in plentiful supply.
- A.G.A. Position: A.G.A. supply estimates indicate that natural gas will be in plentiful supply for use in residential, commercial, and industrial sectors well into the forseeable future. In additon to conventional sources of natural gas, synthetic fuels and other unconventional sources of natural gas will be available to supplement existing natural gas reserves.

  Furthermore, if the building designer/builder feels that there is an inadequate supply of any fuel choice, he/she is not precluded by the BEPS from choosing any other fuel. As stated above, performance standards merely establish energy performance goals and do not prescribe the methods (or the fuel choices) by which the goal is achieved.
- Criticism: The BEPS will preclude the use of our abundant coal reserves.
- A.G.A. Position: The BEPS, as a performance standard, will not preclude the use of any form of energy. If coal-fired electric power is used, the BEPS merely set a reasonable energy consumption level for any building using coal/electric power. With regard to coal gasification, the BEPS, by accounting for efficiency in the energy delivery system, could encourage the efficient use of coal in today's existing gas pipeline system. Major benefits of coal

gasification compared to other uses of coal include reduced environmental impacts, more efficient use of our coal reserves and decreased consumer costs for energy.

- Criticism: DOE should not use BEPS an an instrument to carry out the National Energy Policy .
- A.G.A. Position: Congress required the Department of Energy to develop the Building Energy Performance Standards with a national scope. Thus, DOE is a *de facto* instrument of national energy policy. DOE is charged with implementing policy with respect to the U.S. national energy situation. In addition, DOE is required to consider the effect of any project on the nation's natural resources under several statutes and federal regulations.

SPECIFIC TECHNICAL COMMENTS

- Criticism: The BEPS, as a performance based standard, will be unworkable and overly complex.
- A.G.A. Position: In the case of residential and small commercial construction, DOE has indicated that existing prescriptive energy codes, if considered equivalent, will be allowed to regulate building energy design. These equivalent codes would eliminate any need for a performance based energy analysis.

Existing energy codes currently require *two* annual energy analyses to determine compliance: first, on the building as proposed; and second, on the building itself, assuming that it meets the prescriptive code criteria. By contrast, BEPS would simply require *one* annual energy analysis. Furthermore, if future building designs are similar to one approved under the BEPS, additional analyses would be unnecessary, since the general building design would be the same. Current codes, on the other hand, would still require two analyses, since compliance is achieved on a building-by-building basis.

The state of Florida has enacted a performance standard which includes weighting factors. This Florida format is quite simple, and it requires approximately 20-30 minutes of time from a non-technical person. This performance standard reportedly has the broad acceptance of all aspects of the Florida building industry except the electric utilities. Outside of the U.S., Canada and several European countries have implemented building energy standards using performance approaches which have been working successfully. The performance approach allows more flexibility to the designer to reduce the overall energy consumption without inhibiting innovative building design.

- Criticism: The weighting factors strongly discourage the use of electricity in new buildings.
- A.G.A. Position: The weighting factors do not prescribe a specific fuel choice; rather, the weighting factors merely place energy usage and operating costs on an equivalent basis by taking resource energy consumption from source through final distribution into consideration.
- Criticism: The weighting factors to not distinguish among primary fuel choices for electrical generation.
- A.G.A. Position: While weighting factors do not specifically address the variety of fuels (and their respective efficiencies) which can be used in the generation of electricity, the costs of electricity in deriving the weighting factors reflect the fuel mixes. For example, in the northwest, where hydro-electric power is available, the costs for electricity would be low. On the other hand, in areas of the country where electrical generation is dependent upon nuclear energy, the costs for electricity would be high. Thus, weighting factors implicitly account for the energy lost in the transmission, generation and distribution of electricity. While various fuel mixes will result in different generating efficiencies, the national average efficiencies for electric generation, according to the Edison Electric Institute statistics, have not varied more than 5% in the past 25 years. In essence, regardless of the fuel mix for electrical

generation, the average efficiency of electrical generation has not changed very much in the past 25 years making the fuel mix argument insignificant.

- Criticism: The weighting factors are resource based and are, therefore, inconsistent with the statutory requirements of the Energy Conservation and Production Act (ECPA), which requires an on-site energy use evaluation.

- A.G.A. Position: DOE's statutory mandate to develop and promulgate the BEPS is found in ECPA. The legislative history of this Act does not reveal any Congressional intent to limit the standard to on-site efficiency. Furthermore, ECPA requires that any energy efficiency standard be cost-effective. By implicitly recognizing the natural resource consumption of new construction, the BEPS are consistent with: 1) the statutory intent of ECPA; 2) other related statutes and regulations dealing with energy efficiency; and, 3) established thermodynamic principles.

- Criticism: Weighting factors are contrary to the National Energy Policy.

- A.G.A. Position: A national objective is clearly the reduction of imported oil from OPEC contries. It is also in the nation's best interest to reduce energy consumption within the United States by using our energy as wisely as possible. Weighting factors are essential in determining the effects of various decisions on natural resources because for a given fuel, weighting factors provide insight regarding the total energy cycle efficiency (i.e., the overall efficiency of energy production, transmission and distribution).

- Criticism: The proposed residential energy budget levels are not realistic.
- A.G.A. Position: A.G.A. assumes that the term "realistic" refers to the similarity between BEPS and existing prescriptive energy codes. The BEPS do not account directly for building geometry, ceiling height and roof/wall/floor area ratios, because the budget number relates to the heating requirements per square foot of floor area.

BEPS accounts for the fuel source and equipment efficiency and relates the efficiency of energy use to the thermal integrity of the structure. The entire building/system design is treated as one "package". Prescriptive energy codes contain thermal requirements that are not related to equipment efficiency or energy source. In essence, they relate only to climate and are identical for any given structure regardless of its fuel source or equipment efficiency.

The BEPS' performance approach, by regulating total building/system design, should result in relatively uniform consumer costs for operating a given structure. All gas or electric homes in a given climatic area should have the same relative operating costs when meeting the budget levels. Obviously, if the design budget level were less, the operating costs would be less.

By contrast, with the prescriptive provisions of current energy codes, any complying structure's operating costs could vary across the board because the equipment efficiency, the unit cost of the energy form and thermal requirements are not correlated. A comparison of the minimum requirements of existing prescriptive codes to the proposed BEPS would require the analysis of a multitude of house designs/geometries and energy systems to solve for the projected design energy consumption. The comparison of their design energy requirements would indicate which thermal envelope requirements of the existing codes would meet BEPS for any given equipment efficiency.

- Criticism: The BEPS will create significant liability exposure for professional engineers who design buildings to comply with BEPS.
- A.G.A. Position: The BEPS are designed as energy performance standards only insofar as building design is concerned. The BEPS are not designed to be used as predictive tools. The standard building operating conditions under which the designs are evaluated can never be duplicated in real practice, since these conditions do not include the effects of individual lifestyles. Professional engineers responsible

for designing buildings in compliance with the BEPS should emphasize this primary purpose to the building owner so that the owner does not expect that the building, when completed, will perform as designed.

- Criticism: The BEPS will create confusion in states which have already adopted building energy codes.
- A.G.A. Position: A signficant number of states have adopted ASHRAE 90-75 or the Model Energy Code as their state building energy codes. There has been significant discussion in hearings before DOE that existing state energy codes such as ASHRAE 90-75 should be granted equivalency status. To the extent that this equivalency is granted to ASHRAE 90-75 and other model building energy codes, the BEPS should not create any such confusion.

IMPLEMENTATION

- Criticism: The BEPS will require years for implementation.
- A.G.A. Position: DOE has indicated that its proposed rule on implementing the BEPS will be issued within a very short time after the final BEPS rule has been issued. Assuming a 60-day comment period and a similar deliberative process by DOE prior to issuance of final implementation rule, we can expect that the BEPS implementation mechanism will be in place within 12 months after issuance of the final BEPS rule. However, a more definite time frame cannot be predicted.

OTHER GENERAL ISSUES

- Criticism: By precluding the use of electric power, the BEPS will prevent electric utilities from balancing their present generating loads.
- A.G.A. Position: In essence, the relative proportions of winter-to-summer demands will remain the same. Thus, this argument has no merit. It may be true that today's population of buildings require additional generation capacity to handle summer peaks, and electric utilities need greater winter loads to reduce their operating costs. Buildings constructed under BEPS would contribute additional heating loads to help balance the electric load; however, those new buildings would also require cooling which, if met by electric power, would result in new generation capacity in order to meet these additional demands. If electric utilities desire to balance their seasonal loads, they should concentrate on making existing structures more energy efficient and not on the future population of buildings.

- Criticism: The energy savings from BEPS would be insignificant.
- A.G.A. Position: DOE estimates that BEPS would save about 216,000 barrels per day by 1990. At approximately $40 per barrel in 1990, this savings would amount to over $1 million a day or $365 million a year less imported oil. In addition, BEPS would increase the disposable income significantly for those consumers with BEPS-built

houses. These savings will increase as more and more buildings are built to comply with BEPS. There is a large existing population of houses and buildings, which increases by only about one percent annually. Thus, the effect of BEPS will be a cumulative figure which will increase gradually in the first years of implementation.

AGA
American Gas
Association

April 1980

FACT SHEET FOR THE PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

Background

Title III of the Energy Conservation and Production Act of 1976 (P.L. 94-385; "ECPA") contains a provision for the development and implementation of energy performance standards for new residential and commercial buildings. Pursuant to that provision of the Act, the U.S. Department of Energy (DOE) issued for comments an advanced notice of proposed rulemaking on 11-21-78 and a proposed rule on 11-28-79.

Source-Based Energy Performance Standards

The proposed BEPS are source-based with respect to fuel-use efficiency. Source-based energy performance standards are those which account for the overall efficiency of energy conversion from its source through its ultimate end-use; i.e., through the total energy cycle, which includes production, transmission and distribution, as well as end-use. Such standards evoke awareness of the fact that the amount of energy lost in each step of the total energy cycle depends upon the form of energy involved. Thus, source-based standards encourage the most efficient overall use of energy. The proposed BEPS would assign cost-based weighting factors to different forms of energy. The weighting factor used would reflect the total energy cycle efficiency indicative of the form of energy used in a building. Such a use of weighting factors effectively constitutes a source-based approach to energy performance standards. Clearly, therefore, the proposed BEPS would promote energy efficiency and so serve the nation's best interest.

An inferior alternative to source-based standards would be site-based standards, which only account for the efficiency at the point of energy end-use. Site-based standards neglect the energy losses associated with the other steps in the energy cycle. Thus, site-based standards hide the full impact of using energy inefficiently. Hence, they are clearly not in the nation's best interest. Were the DOE to abandon the concept of weighting factors and fail to adopt some other equivalent source-based methodology, the BEPS would then be site-based; therefore, inferior to the BEPS as presently proposed and in conflict with the intent of the EPCA.

Conservation

The BEPS as proposed would result in better energy utilization, because they would:

- address real energy costs;
- encourage efficiency in energy production, transmission and distribution;
- credit the use of solar energy;
- promote the use of energy from renewable resources by providing a method for evaluating their contributions;
- encourage building design improvements aimed at reducing energy consumption; and,
- foster improvement in appliance efficiencies.

AMERICAN GAS ASSOCIATION 1515 Wilson Boulevard, Arlington, Va. 22209

Environment

Reduced energy resource consumption translates directly to a cleaner environment. Source-based BEPS would contribute to reduced energy consumption at every step of the energy cycle, as explained previously.

Economic Benefits

Source-based BEPS would result in the following:

- lower energy consumption; therefore, lower utility bills and conversely, more disposable income; thus facilitating home ownership in the long term;
- reduced inflation because of less energy demand;
- improved U.S. trade balance via reduction of oil imports;
- increased employment in the private sector due to increased demand for conservation materials and labor; and
- less total energy-related capital investment because of lower overall energy requirements.

Technology Innovation

Performance standards are more conducive to innovation than so-called prescriptive standards (which merely specify materials, types of construction, etc., without addressing performance per se). The BEPS concept would encourage clever and innovative design in buildings by:

- allowing greater design flexibility;
- motivating better understanding of building technology and energy use; and
- permitting designers, owners, builders and consumers to evaluate and compare building/system designs on an equivalent level similar to the EPA mileage ratings for automobiles.

Recommendations

The American Gas Association (A.G.A.) strongly endorses source-based Building Energy Performance Standards, and therefore urges that weighting factors be retained as a key part of the BEPS.

The DOE will transmit a BEPS proposal to the President in time for him to submit it to Congress by August 14, 1980, along with any recommendations he might have. The Congress will then have 90 days of continuous session in which both Houses of Congress must concur as to whether the BEPS will carry sanctions or whether they will be voluntary. A.G.A. has not yet evaluated all of the technical and legal options concerning the proper implementation strategy for the BEPS. At this time, therefore, A.G.A. is withholding its recommendations on the sanctions portion of the rule.

STATEMENT OF
ARTHUR W.G. JONES,
CODES AND ORDINANCES MANAGER
FOR SOUTHERN CALIFORNIA GAS COMPANY,
ON BEHALF OF
THE AMERICAN GAS ASSOCIATION,
BEFORE THE
SUBCOMMITTEE ON ENERGY REGULATION
ON THE
DEPARTMENT OF ENERGY'S
BUILDING ENERGY PERFORMANCE STANDARDS
June 5, 1980

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Mr. Chairman and Members of the Subcommittee:

My name is Arthur W.G. Jones. I am the Codes and Ordinances Manager for the Southern California Gas Company. SoCal is a natural gas distribution company serving central and southern California. In terms of customers served, SoCal is the largest natural gas distribution company in the nation, serving about 3.7 million customers.

SoCal supports the overall basic concept of the building energy performance standards. We strongly favor and support the consideration in the standards of the effects of energy losses in the conversion of an energy resource into a useful energy form, and the energy losses in transporting the energy to a customer.

In fact, as you may know, the state of California for the past two years has been using an energy code developed by the State Energy Commission which does contain provisions that require the use of an energy conversion factor of 10,239 Btu per KWH of annual electricity consumption to account for the efficiency losses in generation and transmission.

It is on the California Energy Commission's energy performance standards that I have been asked to address my remarks today. I was honored to be selected to represent the gas industry on the Advisory Committee that promulgated the California standards under the direction of the Energy Commission. The other members of the Committee were representatives of all phases of the building profession, inspection authorities, public members and also a representative of the electrical industry. From the very outset, it was the general feeling of the Committee that the standards should contain some provision that takes into consideration generation and transmission efficiencies. We had hoped that the addendum to the American Society of Heating and Refrigeration Engineer's energy standard 90-75, Section 12, "Annual Fuel and Energy Resource Determination", would have been ready in time to have been included in our Committee's proposal to the Commission. However, due to delays in public review that would require that this very important subject of generation and transmission would be covered.

The Committee, by resolution highlighting the importance of reflecting generation and transmission losses in the standard, submitted to the Energy Commission the following section for inclusion in the California energy standards: "Section T20-1473 "Comparison of Energy Forms". For the purpose of Section T20-1470 of these regulations, total calculated annual electricity consumption shall be converted to british thermal units at the rate of 10,239 Btu per kilowatt Hour". In essence, this equates to one Btu of fuel to three Btu's of electrical energy, and is also similar to the proposed weighing factors developed by DOE.

The California standards were approved by the Commission and the standards went in effect on July 1, 1978. Since that time, the Commission, its staff and various committees have been reviewing the standards and their effect in California. Several changes and amendments have been made as the result of these reviews but, to date, there have not been any proposed changes by anyone to the sections or provisions that require the consideration of the efficiency losses in generation and transmission.

I have recently checked with two of the larger building departments in our serving area (Los Angeles city and Los Angeles county) plus our own Marketing Group who regularly contact builders and mechanical engineers to see if the current energy regulations containing these source energy requirements have caused any concern within the building industry. No major problems were reported.

With this information in mind, I would once again state that SoCal supports the overall concept of BEPS; that we strongly favor and support the consideration in the standards of the effects of energy losses in the conversion of an energy resource into useful energy form and the energy losses in transporting the energy to a customer; and finally would urge that the approval of BEPS go forward as scheduled without delay.

Mr. LAWRENCE. I know we are racing through here. We have a very detailed statement that addresses a lot of points, and I thought we would have something in the range of 10 minutes to summarize?

Senator JOHNSTON. If you could, make it about 5 minutes so we will have time for questions.

Mr. LAWRENCE. OK. First, Mr. Chairman, I want to emphasize two basic points, and I might say at the outset that I and the gas industry normally find ourselves quite in agreement with you on basic energy policy matters, and I guess in this case we find ourselves apart on both points.

No. 1, AGA does strongly support the concept of measuring overall efficiency from energy sources to utilization and the proposed BEPS regulations do contain weighting factors based on this concept.

They do reconcile the overall resource base efficiency of various fuels and our support for BEPS is based on the retention of this weighting factor concept in them.

Second, we feel that Congress should not adopt legislation which would require a delay in the issuance of BEPS regulations. This is only going to postpone conservation benefits.

Now we are not talking about a delay in the implementation period. As a matter of fact, as you know, the application of mandatory standards is reserved to Congress, and I might add that we are not here in support of mandatory standards. We do feel that the resource base BEPS is a national conservation policy standard which State and local jurisdictions can use as a model for energy conservation in new buildings.

Senator JOHNSTON. What do you say about our friends the home builders there? They say it is too complicated and unworkable, and in the city of Seattle it just won't work.

Mr. LAWRENCE. The answer to that is just what we are prescribing. I think with this as a model, as a standard, Kansas City and Seattle and New Orleans can reconcile those and make it work, and they are doing it in Florida and doing it in California, and as a matter of fact, I think with this BEPS as a model to be guided by they can actually have one analysis to perform instead of two as they now have to provide in Florida, and also in California, but that is one of the reasons, Mr. Chairman, that we are not here talking about the mandatory BEPS, whether cookbook or performance based, but as a model for energy conservation, and if we are going to have a model that should be looked to by various jurisdictions, and right now I think there are some 44 States that do adopt the ASHRAE section 9 standards, and if States are going to look to a national model, we submit that it is essential I think that congressional mandate is to the effect that those standards should be based on the overall resource efficiency and not just on efficiency at the site.

I think that is our answer to the builders, and the fact that in certain States where we have these performance type standards it is working.

I would like to make another point, Mr. Chairman. We are not supporting BEPS as a conservation principle to gain a competitive advantage. We think we are competing in the marketplace now and we think as the supply situation continues to improve, as it will, that we are going to be able to compete better, but we are supporting BEPS as an equitable conservation vehicle for our own residential and commercial market as well, and that is in our homes and buildings, and let me just refer to the Mellon Institute study which your colleagues Senator Lugar and Stevenson——

Senator JOHNSTON. You said the supply situation will improve. You mean the rate of falling behind will be less?

Mr. LAWRENCE. That has already happened in 1979. The rate of falling behind is less in the conventional lower 48 States.

Senator JOHNSTON. Do you expect to find more than 21 trillion TCF?

Mr. LAWRENCE. Yes. I think all of us who are supporters of the deregulation incentives, of the less than perfect incentives that are incorporated, those are working. Exploration is up. The reserve additions in 1979 over 1980 were 35 percent higher, I mean 1979 or 1978 were 35 percent higher than the additions in the previous year. It is the highest in the last 12 years.

We have got drilling rigs at a 20-year high, seismic activity at a 20-year high, and we expected the increased exploration activity to have a 3- to 5-year lag before the production is brought on, but we have seen an even quicker response.

Senator JOHNSTON. I hope you are right, and I have heard those figures before. I just wanted to get that on the record.

Mr. LAWRENCE. Sure. We think certainly within that 3- to 5-year period we will hit the level of certainly 1979, 19.9 trillion cubic feet of production. Some might say that is optimistic. Others say it is pessimistic, but the additions during 1979 were pretty well standard throughout the country. They are not the big, exotic areas of high potential like the Overthrust and Tuscaloosa in Louisiana, et cetera. As those come on with the incentives of the already deregulated deep drilling, things are looking better.

This Mellon study pointed out I think a very interesting result that had we done things right over the last 10 years several things would have happened.

If we had good conservation principles, if we had used things for the proper application, we would have used 30 percent less oil in this country. We would have used 43 percent less electricity. Actually we would have used about 4 percent more natural gas.

Senator JOHNSTON. Let me say there is no argument about that we need standards. We need mandatory standards and need them as soon as possible, but the question is do we want workable standards?

Now I think the main purpose of this panel is to talk about there weighting factors. I came in this morning without much of an opinion on it, and as I sit here it seems to me right now clear that you ought to have the same kind of insulation in a home, the same kind of efficiency regardless of the kind of fuel that is used.

Would you speak to that one issue?

Mr. LAWRENCE. Yes, I sure will, because I think if you don't have a factor and the weighting factor has been bemoaned because it is based on cost to the consumer, and actually that is just a convenient shorthand way of measuring the overall efficiency of production, transmission, distribution, and utilization.

Senator **Johnston**. Natural gas, what do you figure your cost on that, today's price or the price in 1985?

Mr. **Lawrence**. We will project as far as anyone wants to, and we have projected ours out to 1990, and the weighting factors in the BEPS standards are pretty well in line with today's prices.

I might add another point. We have no objection to these waiting factors being designed on a regional basis, but the point, Senator, is if you don't consider the overall resource efficiency in any kind of codes and standards for buildings, then the result is you are going to have a site-based efficiency, and when you do, you are going to mitigate very heavily against your most efficient fuel, and that is why we are strongly supporting the BEPS type principle, but again not mandated at every locality.

Can I get to the point I was coming to a minute ago which is one that has been addressed here a couple of times today, that that 4-percent increase in gas was a product of about a 40 percent less use of gas in the residential and conservation market and a 68-percent increase in the industrial market.

If we could accomplish that, we could replace a great deal of foreign oil in this country. I think in our support of the BEPS increased conservation for gas in the building market is to that end. I think you are very well aware that some of our hope is to remove constraints on the industrial market for gas in the Fuel Use Act, in the elimination of incremental pricing, and to that end we have had a very desirable, or the House has exercised the one house veto on phase 2. They did it by a 10 to 1 margin, so our goal is conservation of gas as well as resource based efficiency treatment.

Very quickly, it has been contended that resource based BEPS or standards are against the intent of Congress. In our prepared statement we have devoted a great deal of documentation to the effect that the ERDA Act and EPCA very clearly point out that overall resource efficiency throughout the entire cycle is the proper measure.

As for administrative complexity, I have already addressed that. Perhaps Mr. Jones could address it more if you have further questions, but the fact is these types of standards are working in Florida and California.

As to adverse effects on builders, and again we are not talking about cramming things down their throat but in Florida they have got an energy index. There are incentives for builders to compete against each other. It is much like the A, B, C comparison that you referred to earlier, and it is working. It is simple. There is a form the builders can fill out in 20 to 30 minutes.

It has been contended that BEPS as proposed is going to take a fuel source, and we say no. Resource based BEPS is not mandate but choice. It will encourage the most efficient fuel, whichever is chosen. If you want to use in certain cases electric heat to meet the energy budget provided here, you may well have to use a heat pump in a particular area, and to that end we would point out that currently the marketable medium to buy a gas furnace with an efficiency of about 70 percent is roughly comparable to some of the new heat pumps with an efficiency of 200 percent, but in that case both systems would use about the same amount of primary energy.

My final point, Mr. Chairman, is the one I have already addressed. Those that are bemoaning gas supply that is inevitably running out are doing a great disservice to the energy policy I think of this Nation because we have got a huge potential. We have taken again some imperfect steps that are working to improve that. We have got a better understanding by the Federal Energy Regulatory Commission and the Economic Regulatory Administration on the benefit of some of our supplemental supplies, coal gasification, gas from Alaska, imports from Canada and Mexico—imports, yes, LNG imports, yes, but preferable to imported oil.

All these I think are corroborating some of the supply projections that we have made.

I thank you, Mr. Chairman. I think Mr. Jones, if you would give him about 30 seconds, could add a point of interest on the California thing.

Mr. JONES. Thank you, Mr. Chairman. My name is Arthur Jones for the Southern California Gas Co. I have been asked to address what is happening in California. I will do it very quickly.

The California Energy Commission in its wisdom appointed a committee to come up with an energy package for California. I was honored to be the representative for the gas utility. I was also the electrical man. All phases of the building industry, the public, inspection authorities, so forth, were on this committee.

From the very start it was agreed by all members that the concept of a resource energy had to be in any energy standard that made any sense at all, so it is in my statement. The Commission accepted it on July 1 and put it into effect, and the committee's recommendation on that one point, resource energy, should be included to have a proper code.

In essence, the requirement equates to 1 Btu of fuel to 3 Btu's of electrical handling. This is very similar to the weighting factors of BEPS. Since they have gone into effect, there have been several changes.

Senator JOHNSTON. We don't have time, I'm sorry, to go into that. Let me ask Dr. Savitz, Dr. Savitz, how would changing from weighted resource base back to a neutral million Btu's per square foot, what would a change back to that do to your schedule?

Dr. SAVITZ. We are analyzing putting the weighting factors on a regional basis. We are also relooking at a site basis that is in our schedule already, both examining just a regional or local State weighting factor, and also analyzing all the data.

Senator JOHNSTON. I mean to go to a nonfuel base so it would be neutral as to different kinds of fuel.

Dr. SAVITZ. If it is a site base, it is more in favor of one versus the resource base or weighting factor. It is hard for people to be neutral, but if we had a site or weighting factor base—it is in our present schedule to review both options now. It will not hold up our schedule.

Senator JOHNSTON. I don't see why it can't be neutral. That is something I missed. Dr. Rosenfeld and Dr. Levine were trying to tell me that, and I couldn't quite catch that point.

Mr. LAWRENCE. We think the resource base is neutral.

Senator JOHNSTON. I know it is not neutral or Bill McCollam wouldn't be here if it was neutral.

Let me let Bill McCollam testify first, and then we will come back and you can tell me why we can't go to something that is neutral if it is the same kind of house, whether you use gas or electricity.

STATEMENT OF WILLIAM McCOLLAM, JR., PRESIDENT, EDISON ELECTRIC INSTITUTE, ACCOMPANIED BY PAUL C. GREINER, VICE PRESIDENT FOR CONSERVATION AND ENERGY MANAGEMENT

Mr. McCOLLAM. Mr. Chairman, I would like to thank you for the opportunity to appear here to comment on BEPS. We have a statement which I have introduced into the record, and I would like to also introduce into the record a rather detailed document[1] which represents our comments to the Department of Energy on the building energy performance standards which will substantiate in great depth many of the points I will make here today.

I certainly will not take time in my testimony to do that here. I ask that both my statement which has been previously submitted to the committee and our comments to DOE[1] which we are handing to the reporter now be permitted to be included in the record.

Senator JOHNSTON. Without objection.

[The prepared statement of Mr. McCollam follows:]

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[1] See appendix IV.

TESTIMONY OF

WILLIAM McCOLLAM, JR.
PRESIDENT, EDISON ELECTRIC INSTITUTE

BEFORE THE

ENERGY REGULATION SUBCOMMITTEE
OF THE
SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

JUNE 5, 1980

Mr. Chairman, my name is William McCollam, Jr. I am President of the Edison Electric Institute.

EEI is the association representing the nation's investor-owned electric utilities. Institute members serve 99.6 percent of the customers reached by this segment of the electric utility industry; they generate more than three-quarters of all the electricity used in the country and serve almost 8 of 10 ultimate customers.

EEI and its member companies are strongly committed to energy conservation and feel that Congress acted wisely in enacting The Energy Conservation and Production Act (P.L.94-385; 42 U.S.C. §6801; "ECPA"). Title III of ECPA, as you know, required that Building Energy Performance Standards (BEPS) be issued because, as stated in Section 302(a), "large amounts of fuel and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings..."

The Department of Energy has strayed, in our judgement, from the intent of Congress in the Proposed Rule issued November 29, 1979 (44 FED. REG. 68120) by addressing energy consumption "in" buildings through a convoluted mechanism called "weighting factors." Regardless of the name given to the process, the concept is that all energy is equal, regardless of its source, and therefore must be accounted for in terms of its source...even if its source is in abundant supply, such as coal or nuclear energy, or cannot be used in any other way than for the production of electricity, such as nuclear, hydro or geothermal energy.

For the electric industry of this country, including not only EEI members, but the American Public Power Association, the Association of Home Appliance Manufacturers, the International Brotherhood of Electrical Workers, the National Association of Electrical Distributors, the National Association of Electrical Contractors, the National Association of Electrical Manufacturers and the National Rural Electric Cooperative Association, weighting factors as proposed by DOE represent a discriminatory 3 to 1 penalty against the use of electricity in new construction. This is a penalty, by DOE's own admission in the Proposed Rule, which would "reduce electricity (use) if the value-based weighting factors given in this proposed rule are used." [1]

This statement seems to be consistent with the objective of conservation. But will weighting factors actually save energy or simply force a substitution of one energy source for another? DOE concluded in the proposed rule that "the use of DOE's proposed weighting factors will not significantly affect the overall energy savings expected to be achieved by the standards." [2]

Since the standard will not significantly affect energy savings, by DOE's own admission, one must ask what will be its impact, particularly on the electrical industry and on the overall national energy situation?

Arthur D. Little, Inc. (ADL)[3] found, in a report prepared for DOE, that a mandatory source energy approach to conservation standards, such as the use of weighting factors, would have at least four major points of impact:

-- First, application of conservation standards containing a source energy approach to all construction between 1978 and 1990 would result in a decrease of more than 8 percent of the electrical energy which would have been delivered to those structures; energy which will be replaced by other fuels, since "the use of DOE's proposed weighting factors will not significantly affect the overall energy savings."

-- Second, the resultant poorer load factors would require a 6% rate increase over and above inflation, an increase in energy cost for consumers who, in the end, must pay for this fuel displacement program.

-- Third, such an approach would deny the electrical industry access to most of the new residential heating market which would result in a reduction of 11,000 jobs in the electrical industry, according to another study conducted for DOE by Battelle Pacific Northwest Laboratory.[4]

-- Fourth, it could well rule out electric heat pumps, as well as electric resistance heating, in most areas of the country.

In other words, DOE has said that weighting factors won't significantly affect total energy use, but that they will cause a shift from the use of electricity to oil and natural gas (verified by the Battelle study)...a shift which ADL calls a "potential bonanza."

To carry this just one step further, if we acknowledge that Arthur D. Little, Battelle, DOE and EEI are correct in forecasting a shift away from the use of electricity and to the use of oil and gas as a substitute, one must ask how such an action would affect the overall national energy outlook. I submit that the President had the answer when he addressed this issue in the National Energy Plan. I quote:

> "...conserving oil and natural gas is more important than saving coal."

The National Academy of Science has also recently concluded that "Coal and nuclear power are the only large-scale alternatives to oil and gas in the near term (before about 2000), as the use of fluid fuels begins to wane. Both are best suited to the generation of electricity in this period."

Indeed, if such a shift away from electricity and to the use of oil and gas is to be encouraged, the synfuels legislation should have been enacted several years ago. In essence, weighting factors will cause gas and oil produced by the $20 billion synfuels subsidy package to be burned up even more rapidly.

I don't want to belabor this point, but weighting factors, source energy concepts, RUF's* and RIF's*, or whatever you choose to call them, are an insidious effort which will create an expanded market or demand for oil and particularly natural gas.

I think a great deal of this needless activity could be avoided by instructing the Department of Energy to simplify the massive effort that they have undertaken. It has been reported to me that 42 of our

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* RUF (Resource Utilization Factor)) used in the Advanced
* RIF (Resource Impact Factor)) Notice of Proposed
Rule Making

50 states have very fine building energy conservation standards already in place and these standards were put in place at the encouragement of the Department of Energy, using funds that were supplied by Federal programs. The work that has gone into implementing these various state programs should not be made worthless by the institution of another Federal energy conservation standard. To this end, our association has recommended that the initial effort of the Department of Energy should be to equate BEPS to the existing 42 Model Energy Conservation Codes. As now structured, BEPS could set back the progress of energy conservation at the state level for years.

Such an approach would:

1. Put the program in place with minimum impact on the various state programs;
2. Eliminate the need for mandatory development of a complex certification methodology;
3. Allow for the orderly testing and refinement of the building performance concept vis-a-vis the prescriptive approach now in use;
4. Allow for a transition period if the performance concept can be shown to be superior;
5. Accelerate energy conservation in new construction throug avoidance of the inevitable, protracted litigation which the Proposed Rule may stimulate; and
6. Reduce economic pressure on the troubled construction industry and the potential home-buying public.

The Institute therefore concludes that a source energy concept, as included in BEPS through the mechanism of "weighting factors", is counter-productive to our nation's stated energy policy. This policy has been enumerated by Congress in:

1. The Power Plant and Industrial Fuel Act of 1978. (Public Law 95-620) lists as statements of purpose in Title IX, Sec. 102.(b).
    a) "to reduce the importation of petroleum and increase the Nation's capability to use indigenous energy resources..."
    b) "to conserve natural gas and petroleum for uses... for which there are no feasible alternative fuels or raw material substitutes;"
    c) "to encourage and foster the greater use of coal and other alternate fuels, in lieu of natural gas and petroleum..."
    d) "to prohibit or, as appropriate, minimize the use of natural gas and petroleum...for the benefit of present and future generations."
2. Public Law No.95-618 "Energy Tax Act of 1978", Title III, includes in the title "to Encourage Conservation of, or Conversion from, Oil and Gas"
3. Public Law No.95-619 "National Energy Conservation Policy Act" under Title I, Sec. 102 states:
    "The Congress finds that -
    a) "the United States faces an energy shortage arising from increased demand for energy, particularly for

> oil and natural gas, and insufficient domestic supplies of oil and natural gas to satisfy that demand;"

With the Congress and the American Public so interested in conservation of oil and gas, it makes little sense to mandate its preferential use over electricity made predominantly - with coal, hydro and nuclear.

1/ Notice of Proposed Rulemaking, Energy Performance Standards for New Buildings, November 1979, at 2.41.

2/ Notice of Proposed Rulemaking, Energy Performance Standards for New Buildings, November 1979, at 2.41.

3/ Arthur D. Little, Inc., An Impact Assessment of a Mandatory Source Energy Approach to Energy Conservation in New Construction (August 1979). This report, prepared under contract for the Department of Energy, assessed the impact of a mandatory source energy approach on energy consumption in buildings, fuel selection, equipment manufacturers and building designers. A report prepared by AIA Research Corporation, Source-Based Energy Budgets: Possible Impacts of Measurement Beyond the Building Line (March 1978), reached many of the same conclusions.

4/ Battelle Pacific Northwest Laboratory, Economic Analysis of Proposed Building Energy Performance Standards (Sept. 1979), at 7.4, 7.6, 7.7. Based on 1970 dollars and assuming 100% compliance with BEPS in 1980, it is estimated that by 1990, both electricity investment requirements and domestic production of electricity will have decreased by more than $1 billion, and electric utilities will have 11,000 fewer available jobs. Id. at 7.5, 7.6, 7.7.

Mr. McCollam. I am accompanied by Mr. Paul Greiner to my right who is EEI's vice president for conservation and energy management who has dealt over a long period of time with the details of these regulations and who as a matter of fact has testified in the Department of Energy hearings on BEPS. He is here to answer any technical questions which I may not be able to field.

I would like to make several major points by way of summary. EEI and its member companies are strongly committed to energy conservation and feel that Congress did act wisely in enacting the Energy Conservation and Production Act in 1976.

Title III of the act commonly called ECPA as you know required that the building energy performance standards on which we are having the hearings today be issued in order to save large amounts of fuel and energy which in the judgment of the Congress were being consumed unnecessarily each year in heating, cooling, and ventilating and providing domestic hot water for the residential and commercial buildings.

I think one of the important points that has not been adequately aired today which I would like to emphasize, and which certainly has been alluded to, is that in our judgment the Department of Energy has exceeded the statutory authority in ECPA and has in our judgment also strayed from the intent of Congress and its proposed rulemaking by addressing energy consumption in buildings through what we feel is a very convoluted mechanism called weighting factors. You addressed that point earlier in some of the questions you have raised.

I would submit to you, sir, that the DOE has in fact exceeded its statutory authority and has strayed from the intent of Congress if you look at the legislative intent which led up to the enactment of this legislation.

For the electric industry of this country, including not only EEI members but the public power sector as well, the American Public Power Association, the National Rural Electric Cooperative Association, the various electric manufacturers associations, this particular scheme of building energy performance standards does in fact assess a discriminatory penalty, a three to one penalty, as a matter of fact, if you look at the weighting factors against the use of electricity in new construction.

This statement on its face might seem to be consistent with the objective of conservation, but I raise the question, the serious question will these weighting factors actually save energy or will they in fact simply force a substitution of one energy source for another.

DOE, as a matter of fact, concluded in the proposed rule, and I am quoting from DOE's statement, "The proposed weighting factors will not significantly affect the overall energy savings expected to be achieved by the standards."

Since the standards will not significantly affect energy savings by DOE's own admission, I think one must necessarily ask what is going to be the impact on the overall industry situation.

Senator Johnston. I think we have gotten into that. Why is it not neutral to say that if you are going to have performance standards, you base it on delivered Btu's per square foot?

Mr. McCollam. We would be in favor of that. In other words, what you are suggesting, Senator, now and as I understand from some of the questions you asked earlier, you are suggesting that we look at the onsite energy efficiency not going all the way back to the source through what we have described as this mechanism?

Senator **Johnston**. A tax credit for storm windows or insulation; they don't give those tax credits based on whether you are using oil or gas or anything else. It is just based on you get it to insulate your home. I can't understand why we ought to penalize the guy because he uses electric heat or give him a bonus because he uses another kind of heat.

We ought to have a standard that ought to be a standard.

Mr. **McCollam**. We are in full accord with that, and our basic objection to the use of weighting factors is what you just put your finger on and what you have stated earlier, and the questions you have asked the other witnesses.

We would be in accord with that type of approach. We think it would make sense from the point of view of conservation and national energy policy. The fact is the implementation of these building energy performance standards will shift the utilization of energy toward oil and gas and away from electricity. That is fairly evident if you look at the record on this, through the use of weighting factors which we are vigorously opposed to.

Senator **Johnston**. Now let's say—this is not being neutral, George—let's say it is making a choice. Is it making the wrong choice and if so, why?

Let's say we just told DOE to go make its site specific or whatever it is, onsite evaluation so that you talk about delivered Btu's per room. Why is it making the wrong choice?

Mr. **Lawrence**. I think, Mr. Chairman, where you have been referring to the so-called cookbook or prescriptive type standards it really doesn't matter. I mean that is going to say so much insulation is going to achieve so much desirable conservation, yes, but when you get into a performance standard as BEPS is, and as many individual States are attempting to achieve, a performance standard of a certain energy budget that should accommodate a certain structure, then if you measure that budget by only the energy used at the site and not the inefficient energy losses all the way to the production and transmission system, that is inequitable. It is wrong. It is uneconomic. It is energy inefficient. It is harmful to the environment, all of the above, but if you go to the performance standard, you do need to consider the overall efficiency of the cycle, but I think the point that you continue to focus on of the cookbook of prescriptive standard, I guess it doesn't matter.

Senator **Johnston**. Let me ask you this. Why would anybody use electricity over gas if gas is available?

Mr. **Lawrence**. It beats the hell out of me.

Mr. **McCollam**. Mr. Chairman, might I address that question? There are vast regional and local differences in terms of relative economics of electricity and natural gas. We have already addressed that in some of the questions asked the earlier witnesses.

I think what you are doing here in the building energy performance standard is you are mandating an economic choice rather than leaving the economics to the free marketplace. I think we should mandate the efficiency standards with respect to energy and leave to the individual consumer the choice of the energy forms he uses which is basically what is done now. We think it is a mistake to mandate that type of choice to the consumer.

Senator JOHNSTON. I think so, too.

Mr. LAWRENCE. Unless the choice of energy is a clear one for the Nation, and I don't think—at best, it is not clear here, and I think we can make an argument that we ought to encourage electricity over gas.

Now I know the countervailing argument. I am scratching and clawing to get section 301 amended, as you know.

Mr. LAWRENCE. We are helping.

Senator JOHNSTON. We just don't have enough gas, and I hope we will produce 25 TCF and if we do, we will have plenty of use for it. Don't you worry about it.

Mr. LAWRENCE. On the mandate, again we are not mandating this. In fact, in those States where they have the prescriptive or cookbook, it will fall where it will, but in those States that want to voluntarily go to some sort of performance standard, we would vigorously oppose any sort of a national model that would say site-based efficiency performance standards only. It ought to be just the reverse. It ought to be the overall efficiency as a model, and the individual States can play with that however they want to.

Senator JOHNSTON. Let me ask Dr. Savitz, on your cookbook, will it make any difference what kind of fuel you use?

Dr. SAVITZ. Right now the current HUD standards have a different standard for oil and a different standard for electricity, so in all likelihood they will be following that model from our budget. There may be a difference. We do have some differences.

Senator JOHNSTON. AGA would not object to going back to one standard even though HUD might have two?

Mr. LAWRENCE. Can I let Mr. Cuccinelli respond to that?

Mr. CUCCINELLI. The question that we are bandying about is the onsite and offsite, and from a technical standpoint in the electrical system two-thirds of your losses are before you get to the building.

Senator JOHNSTON. I understand that.

Mr. CUCCINELLI. And so if you go just to an onsite consideration, then you are really penalizing the coal, oil, and gas systems.

Now HUD has set a precedent where they consider electricity and they consider oil and gas separately, and so they have in their judgment call said because of the economics of the operation of that house we need different levels.

Senator JOHNSTON. The answer to the question was yes, you would object if they went to one standard?

Mr. CUCCINELLI. That's right.

Mr. JONES. Mr. Chairman, since some 3 years that the source energy has been in California, there has been no effort by anyone to change that one facet. There have been other amendments, but not under the source.

Senator JOHNSTON. California is different.

Mr. LAWRENCE. In Seattle where you have the low cost hydropower, I think the Puget Power Co., has requested the State commission for a moratorium on electric heating because they see their future electricity requirements as being nonhydro, thermal generated, at a much higher price and with much more problems.

Mr. CUCCINELLI. Senator, on the HUD standards, another point is that heat pumps and gas systems are handled at the same insulation levels, and that is an acceptable point.

The one that they are significantly more tough on is resistance heat, and that may be an approach that might work out.

Mr. MCCOLLAM. Mr. Chairman, just two or three other points that I think are pertinent to this discussion, as we read the various laws and actions that the Congress has taken in recent years, and not only the Congress but the President in his articulation of national energy policy and as he recommends it to the Congress, the Congress and the President separately and repeatedly have articulated policies and established public laws to support energy conservation, No. 1, in general, and to provide for shifts away from oil and gas in particular in various legislation.

Many of these bills I have cited in my detailed statement which I have submitted for the record. I think BEPS must be appraised in the light of its instrumentality in promoting energy conservation to start with, and shifting away from oil and natural gas specifically, and I think if you look at the weighting factors objectively, you will see that they simply do not meet both of those tests of energy conservation and shifting away from oil and natural gas by unduly penalizing the other source which is electricity.

Senator JOHNSTON. Frankly I don't want to move away from oil and gas or move to anything. I want to deal, it seems to me, with insulation as insulation and leave that choice of fuels to the marketplace or the consumer because it is very difficult to tell what these costs are going to be.

Natural gas, George, I hope you can find enough of it to hold that price down until 1985. I suspect it will go up greatly.

Mr. LAWRENCE. It is on the rise, but in 1990 electricity is still going to be 2½ times higher, and No. 2 fuel oil 40 percent higher by our projections in 1990.

Senator JOHNSTON. No. 2 fuel oil 40 percent higher than natural gas?

Mr. LAWRENCE. By our projections; it is 70 to 100 percent higher throughout the country.

Senator JOHNSTON. But natural gas is price controlled now.

Mr. LAWRENCE. True, but our projections in 1990 have been phased out under the formula, including the deregulation of deep gas between now and 1985, NGPA, and the oncoming of supplementals which are at substantially higher prices than the old regulated price of gas. It is when you compare those supplemental higher cost supplies of gas not with other sources of gas but with alternatives such as imported oil or electricity, then they don't look so hot.

Senator JOHNSTON. You don't lose your advantage by setting insulation standards. Your advantage is in that marketplace. That is why I ask why does anybody, if you have a market advantage in natural gas, which you do in virtually all parts of the country I would guess, there may be some where electricity is cheaper and maybe the new heat pumps are going to be a little better, but in most places natural gas is better and most people know that and are headed to buy gas if they can.

Mr. **Lawrence**. Yes, sir, and again the cookbooks are prescriptive standards, and they aren't going to tilt it one way or another, but if you get into performance stndards to set a budget, then if you don't consider the overall resource based efficiency, you are going to tilt against gas and in favor of the higher site efficiency only of electricity.

Mr. **McCollam**. Could I make one additional point to be sure for the record that you understand? I think you have heard me say this before in previous testimony that our industry is committed to the development of all forms of energy. We need both natural gas and we need electricity in this country.

I think our basic objection to the BEPS regulations is it makes an arbitrary judgment between gas and electricity, building into these standards rather than leaving these choices to the consumer and the marketplace and rather than addressing the fundamental question of insulation as you have indicated earlier in your questions, and the efficiency on site.

Senator **Johnston**. Let me ask this one last question to Dr. Rosenfeid. Why can't you go to the site-specific standard like I was talking about? Mechanically will it work?

Dr. **Rosenfeld**. There is an enormous piece of confusion going on here. What you gentlemen spent the last half hour on has nothing to do with weighting factors. I tried to say that before, but let me try to get your attention on it again.

Let's go back to the point Maxine Savitz just made. If you are dealing with heating only, the problem of how much insulation you should put in depends on whether fuel is expensive or cheap, and that problem has been recognized for a long time by HUD in its minimum property standards, and when HUD passed minimum property standards, it said if you are going to have gas-heated houses, gas is cheap, and it doesn't pay to require very much insulation.

If you are going to have electrical resistance heated houses, that is more expensive and so it pays the homeowner to put in more insulation. That has been around for a long time and has nothing to do with weighting factors, and I don't think it discriminates against one or the other. It just helps the consumer, so everything about discriminating against electricity and gas, that discussion has gone on as if this has something to do with weighting factors, but it is not true.

Senator **Johnston**. What do weighting factors have to do with it?

Dr. **Rosenfeld**. When you do a tradeoff between heating and cooling in the same building, and that is not the point that I understand has been addressed.

Mr. **Lawrence**. That's wrong.

Senator **Johnston**. Excuse me?

Mr. **Lawrence**. I say that's wrong.

Mr. **McCollam**. That is something we would even agree with AGA on.

Dr. **Rosenfeld**. I think I would like to make the assertion that the budgets that have been worked out, if you make no tradeoffs afterwards, the budgets are worked out on the basis of economics. It is called life-cycle costing.

Gas is costed at its natural price which is probably a mistake because it is regional. Electricity is costed at its natural price and the budget calculated, the weighting factors only have to do with tradeoffs that people want to make later if they don't like the particular cookbook design that is published, and you are going to have that problem later, but the weighting factors are not meant that there is a basic problem of should an electrically heated house have better insulation?

It probably should to protect the consumer, but the weighting factor does not enter into that calculation.

Senator JOHNSTON. It is 1 o'clock and we just have EEI and AGA to agree. We probably ought to end on that note.

Mr. LAWRENCE. Could I agree on one other point, on Bill's point about needing all sources of energy to meet our national energy goals? We subscribe to that. We are here and this is the principal area where electricity and gas do compete vigorously, but we are marching together, for example, on the amendments to the Fuel Use Act that you are so familiar with, and just some concepts on the select use of natural gas with coal in S. 2470, the oil backout bill, and elsewhere that we think will enhance the utilization of coal in this country and a reduction of foreign oil.

Thank you.

Senator JOHNSTON. You are both in favor of economic growth?

Mr. MCCOLLAM. Yes; we must have economic growth and if we have economic growth, we must have energy growth.

Senator JOHNSTON. All right. The next meeting of the Committee will be June 17.

Thank you very much.

[Whereupon, at 1:05 p.m., the hearing was recessed, to reconvene Tuesday, June 17, 1980.]

BUILDING ENERGY PERFORMANCE STANDARDS IMPLEMENTATION ACT OF 1980

THURSDAY, JUNE 26, 1980

U.S. Senate,
Subcommittee on Energy Regulation,
of the Committee on Energy and Natural Resources,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:20 a.m., in room 3110, Dirksen Office Building, Hon. John A. Durkin, presiding.

Present: Senator Durkin.

Also present: Benjamin S. Cooper, professional staff member, and Gary Barbour, professional staff member for the minority.

OPENING STATEMENT OF HON. JOHN A. DURKIN, A U.S. SENATOR FROM THE STATE OF NEW HAMPSHIRE

Senator **Durkin**. Good morning, ladies and gentlemen. In the interest of time, I will spare you the opening statement. I will insert my opening statement in the record along with a statement from Senator Wallop, the text of S. 2862, and we will go right to the witness list.

[The prepared statements of Senator Durkin, Senator Wallop, and the text of S. 2862 follow:]

Statement of Hon. John A. Durkin, a U.S. Senator From the State of New Hampshire

Today the Subcommittee on Energy Regulation is holding a second day of hearings on the Department of Energy's proposed Building Energy Performance Standards program. This hearing was scheduled at my request because it was evident to me that there are a lot of problems with the proposed rule issued by the Department of Energy on November 28, 1979.

It was also evident that one day of hearings would be insufficient to record the spectrum of views on this program. The purpose of this hearing, then, is to give those affected by the BEPS program a chance to contribute to that record. The length of today's witness list is testimony to the controversy surrounding this proposed rule.

This all adds up to a clear indication that the Department ought to take another look at what they are doing. To their credit, the DOE witnesses acknowledged this at our last subcommittee hearing on this matter. At that hearing, DOE stated that a new proposed rule would be issued by February, 1981 and a final rule would be promulgated no later than August, 1981. The June 5 DOE statement also talks in vague terms about "field testing" the BEPS program.

If this is what happens, so much the better. But I intend to make sure it happens. Accordingly, this week, I introduced S. 2862, the Building Energy Performance Standards Implementation Act of 1980. I will insert a copy in the record of this hearing at the end of my remarks. This bill:

Shifts the deadline for the final BEPS rule to August 1981;

Directs the President to establish a voluntary program to encourage implementation of the standards contained in this final rule;

Postpones Congressional review of the standards and the mandatory sanction set forth in the Energy Conservation and Production Act until October, 1983;

Consolidates implementation and development responsibilities for the BEPS in DOE; and

Requires DOE, in consultation with HUD, to submit a report on alternative sanctions for the program early in 1981 so that Congress will have an opportunity before October 1983 to enact legislation establishing a different mandatory sanction if this seems advisable.

I am looking forward to hearing from the witnesses today on their views about this bill, the BEPS program, and the administration's new schedule for BEPS announced on June 5.

STATEMENT OF HON. MALCOLM WALLOP, A U.S. SENATOR FROM THE STATE OF WYOMING

Mr. Chairman, I would like to commend the Department of Housing and Urban Development and the Department of Energy this morning, for their efforts to carry out the difficult task of developing energy performance standards for new buildings as defined in the Energy Conservation and Production Act of 1976. The task of developing building energy performance standards proposed by the Department of Energy may be detracting from the progress that has been made and is being made in improving energy efficiency of new buildings through existing state and local regulations and initiatives.

The traditional American Dream of "a home of our own"has become unattainable for a large segment of our population. In our zeal to preserve the quality of our communities and our lives, we have piled restrictions upon regulations upon codes, until finally, we are making unattainable the very things we have sought to protect. No one who has paid a heating or cooling bill in the last several months can deny the importance of energy conservation. In our effort to become energy efficient, BEPS should not become additional government regulations that will add to the unnecessary costs of excessive goverment regulations.

I support the Senate's approval to delay the requirement for final promulgation for BEPS for up to two years until August 1, 1982. This should allow DOE sufficient time to promulgate building energy performance standards which are more reasonable and practical. I am pleased with the Department of Energy's willingness to: (1) conduct a new round of hearings, and to issue a final Standard as soon as possible thereafter but no later than August 1981; (2) conduct field testing of the BEPS program in states that want to take the lead in meeting BEPS standards; and (3) to attempt to effectively communicate with the groups that have offered to help in developing the BEPS Program.

It is clearly in the best interest of the Nation to conserve energy in new buildings. With the relaxation of the Congressionally set time constraints, plus DOE's working in partnership with the building community, the goals being sought should be realized in a timely manner without great costs to the housing consumer.

96TH CONGRESS
2D SESSION

S. 2862

To amend the Energy Conservation and Production Act to provide for a realistic schedule for the promulgation and implementation of energy efficiency performance standards for new commercial and residential buildings, and for other purposes.

IN THE SENATE OF THE UNITED STATES

JUNE 23 (legislative day, JUNE 12), 1980

Mr. DURKIN introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

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A BILL

To amend the Energy Conservation and Production Act to provide for a realistic schedule for the promulgation and implementation of energy efficiency performance standards for new commercial and residential buildings, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Building Energy Performance Standards Implementation Act of 1980".

FINDINGS AND PURPOSES

SEC. 101. (a) FINDINGS.—Congress finds that—

(1) the establishment of reasonable, practical, and cost effective energy efficiency performance standards for new residential and commercial buildings will serve the national interest by conserving domestic energy supplies and reducing the dependence of the United States on insecure sources of imported petroleum; and

(2) the complexity of such standards could limit the energy savings achieved through the standards unless a realistic implementation program is adopted, including a trial program to test the practical feasibility and cost effectiveness of the standards.

(b) PURPOSES.—It is therefore the purpose of this Act to—

(1) extend the deadline for promulgation of final new building energy efficiency performance standards under title III of the Energy Conservation and Production Act (42 U.S.C. 6831–6840);

(2) establish a voluntary program to test the implementation of such performance standards; and

(3) provide for implementation of the standards by the Secretary of Energy.

DEFINITIONS

SEC. 102. For purposes of this Act the term "Secretary" means the Secretary of Energy.

FINAL PERFORMANCE STANDARDS

SEC. 103. Paragraphs (1) and (2) of section 304(a) of the Energy Conservation and Production Act (42 U.S.C. 6833(a)) are amended by striking out "within 6 months after the date of publication of the proposed standards" in the last sentence of each such paragraph and inserting in lieu thereof "by August 1, 1981".

VOLUNTARY IMPLEMENTATION OF STANDARDS

SEC. 104. (a) PRESIDENT'S PROGRAM.—The President shall establish a program in accordance with this section to encourage the adoption and enforcement of final performance standards promulgated under paragraphs (1) and (2) of section 304(a) of the Energy Conservation and Production Act.

(b)(1) ASSISTANCE PROGRAM.—The President's program under subsection (a) shall provide for appropriate financial and technical assistance to any State for the implementation of the standards referred to in subsection (a) in all or a portion of such State if—

(A) the Governor of such State submits an application for such assistance to the Secretary describing a State plan for implementation and enforcement of the standards;

(B) the Secretary finds that such plan is likely to result in adequate compliance in the jurisdictions in which implementation and enforcement of the standards are proposed; and

(C) such application demonstrates, to the satisfaction of the Secretary, that the intended use of assistance under the application are required to achieve an adequate and timely test of the practical feasibility and cost effectivness of the standards.

(2) The Secretary, in consultation with the Secretary of Housing and Urban Development, shall within one hundred and eighty days after enactment of this section, promulgate regulations describing the manner in which application for assistance under this section may be made.

(3) The Secretary may make grants of financial and technical assistance to any State submitting an application which complies with this section.

(4) There is authorized to be appropriated for purposes of this section not more than $10,000,000 for each of the fiscal years ending September 30, 1982 and September 30, 1983.

(c)(1) ADDITIONAL ACTION.—The President's program under subsection (a) shall include such actions as are authorized under any other law which actions the President determines to be appropriate to achieve the purposes of this Act, including the use of authority available to the Secretary, the Secretary of Housing and Urban Development, the Secretary of Defense, and the Administrator of the General Services Administration to provide for the implementation and enforcement of the standards referred to in subsection (a).

(2) Nothing in paragraph (1) exempts any agency or department of the Federal Government from any administrative requirement of existing law relating to an action proposed to be taken under the President's program under this section.

CONGRESSIONAL REVIEW

SEC. 105. Subsection (c) of section 305 of the Energy Conservation and Production Act (42 U.S.C. 6834(c)) is amended by striking "to both Houses of Congress upon the date of promulgation of such standards pursuant to section 304(a)" and inserting in lieu thereof ", as amended to incorporate improvements the Secretary considers appropriate, to both Houses of Congress on October 1, 1983".

TRANSFER OF FUNCTIONS

SEC. 105. (a) Section 303 of the Energy Conservation and Production Act (42 U.S.C. 6832) is amended—

(1) by striking out clause (1) and inserting in lieu thereof the following:

"(1) The term 'Secretary' means the Secretary of Energy."; and

(2) by striking out clause (11) and redesignating clauses (12) and (13) as clauses (11) and (12), respectively.

(b) Section 304 of such Act (42 U.S.C. 6833) is amended by striking out the word "Administrator" the first time it appears in subsection (a) (1) and (2) and inserting in lieu thereof "Secretary of Housing and Urban Development".

(c) Sections 304(c) (42 U.S.C. 6833(c)) and 310 (42 U.S.C. 6939) of such Act are amended by striking out "the Administrator," the first time it appears in each section.

(d) Section 304 of the Department of Energy Organization Act (42 U.S.C. 7154) is amended—

(1) by striking out subsection (a); and

(2) by striking out the subsection designation "(b)".

STUDY

SEC. 106. The Secretary, in consultation with the Secretary of Housing and Urban Development shall conduct a study and report to Congress no later than February 1, 1981, on alternative sanctions for noncompliance with the standards referred to in subsection 104(a). Such report shall include the recommendations of the Secretary and the Secretary of Housing and Urban Development.

Senator **Durkin**. One of the reasons that there are so few people here this morning is that the majority leader has called a caucus of the Democratic Senators, and most of them are at the caucus.

Panel No. 1 is Mr. Joseph Newman and Dr. Mark Cooper.

STATEMENT OF JOSEPH H. NEWMAN, CHAIRMAN OF THE BOARD, NATIONAL INSTITUTE OF BUILDING SCIENCES, ACCOMPANIED BY GENE C. BREWER, PRESIDENT

Mr. **Newman**. Mr. Chairman and members of the subcommittee my name is Joseph Newman. I am chairman of the board of the National Institute of Building Sciences, more popularly known by its acronym, NIBS.

With me today is the president of the institute, Gene Brewer.

We welcome this opportunity to appear before the subcommittee to present the synopsis of our full testimony previously submitted for the record.

Not only because of the specific mission established for NIBS with respect to BEPS and the Energy Conservation and Production Act of 1976, but because of the broader mission established for NIBS in its own authorizing legislation, Public Law 93-383, we welcome this opportunity.

Among other things, NIBS was created to foster the use of performance standards in building regulation and break the barriers that constrain innovation in housing and building.

In the NIBS authorizing legislation, Federal agencies are encouraged by the Congress to accept the technical findings of NIBS and help it achieve its goals.

NIBS is unique, working each day to resolve differences among the many diverse elements of the housing and building community and on behalf of the public through a voluntary consensus process and in a way that brings representation from all the interests, including consumers, as required by its enabling legislation.

The intent was to avoid the very kind of divisiveness that has been created by BEPS.

What we are proposing today, as a result of that process, is a course of action which we believe will put the BEPS program on a sound and productive track, based on cooperation rather than confrontation.

The NIBS approach lets the constituencies, the public, of the Congress do most of the work on a voluntary basis and encourages the building community to solve its own problems.

This reduces emotionally based decisions, helps elicit the best from people and reduces the cost of Government involvement. Most importantly, it gets the job done.

Unquestionably, design standards for energy conservation in buildings are important to the Nation's energy conservation efforts. However, it must be recognized that, to produce the desired results, not only must they be technically sound, but the manner in which they are created, promulgated and implemented must be such that they will work within the immensely complex housing and building regulatory structure that already exists at all levels of government.

The Energy Conservation and Production Act of 1976 directed that NIBS be involved in the development of BEPS and that NIBS serve as the vehicle for building community input into the entire BEPS development and implementation process.

The term "building community" means all the participants in the process, both public and private, including consumers, labor, model code bodies, regulators, designers, builders and contractors, manufacturers, suppliers, and many more.

That is precisely the constituency of NIBS and the NIBS' consultative council that was provided for in the NIBS enabling act and from which we believe the Congress intended NIBS to derive a large measure of its authoritativeness.

The NIBS consultative council today has nearly 300 organizational members and more than 650 individual members. The organization members, in turn, represent literally hundreds of thousands of individuals, large and small businesses and institutions, both public and private.

Unfortunately, NIBS participation in the evolution of BEPS was substantially more limited than we believe the statute contemplated and the building community and NIBS expected.

NIBS simply was not allowed to become involved in a substantive way early enough to function as the facilitator and coordinator of input from the broad-based building community—that is, input that would have been useful in developing a proposed BEPS that would be practical and responsive to the objectives of the 1976 act. It is not too late.

However, what is needed now is not emergency actions, but a sound, cooperative effort in which consumers, the building industry, and government at all levels pull together to set and then meet progressively higher performance goals.

NIBS stands ready to perform its statutory function in this regard acting as coordinator of participation by the building community and as adviser to the Congress and the executive branch.

The centerpiece of NIBS participation in BEPS in its effort to bring about this cooperative effort is its April 30, 1980, report to the Department of Energy in response to the Department's November 1979 notice of proposed rulemaking.

We request that this report of NIBS and the accompanying press release be included in the subcommittee's hearing record.[1]

NIBS believes that its report fairly portrays the collective views and consensus of all concerned, even though individual elements of the building community are expressing their own views today and at other times.

NIBS has concluded, based upon its findings described in its report, that the BEPS have such serious problems and so many deficiencies that it is inadvisable to proceed with the currently scheduled promulgation date.

We do not believe that BEPS in is present form will serve the ends envisioned by the Congress in creating the BEPS program; that is, positive, innovative actions to conserve energy in new housing and buildings.

Therefore, NIBS recommends that the legislatively mandated promulgation date of August 14, 1980, be deferred until the technical and structural defects in the standards are corrected and revised proposed standards are published and subjected to review and comment.

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[1] See appendix V.

Additionally, the institute recommends that concurrent with refinement of the proposed standards, an implementation strategy and proposed implementation regulations be developed.

Those regulations should be published at the time as the new proposed standards for, in our view, producing standards without the means for introducing them into the mainstream of the building regulatory system will seriously jeopardize the total effort.

Further, before the process of revising the proposed standards and developing implementation regulations starts, NIBS believes that the building community should be afforded the opportunity to contribute to formulation of the plan of research and other contemplated work.

With respect to the matter of facilitating acceptance of the standards once developed and published, NIBS recommends that the building community, which includes State and local regulatory agencies, be given ample time to adopt to the standards on a voluntary basis.

Two years would seem to be a minimum period because not only will it take this long to demonstrate the efficacy of the standards and work out any bugs, but several States still have biennial or truncated legislative sessions every other year.

NIBS recommends the following schedule for developing, promulgating, and implementing standards: One, a combined notice of proposed rulemaking for the standards and their implementing regulations by June 1981, 1 year from now; two, a 60-day public comment period thereafter; three, publication of final standards and their implementing regs no later than December 1981; four, a 2-year period for voluntary compliance with the standards; and, finally, at the conclusion of the 2 years, by the end of 1983, the impact of the program should be assessed and a determination made as to the necessity of making the standards mandatory.

The additional time for standards refinement provided by the NIBS timetable would provide an opportunity for all concerned to ascertain the actual performance of buildings through demonstrations or otherwise that are constructed in accordance with the requirements of BEPS or their equivalent and to compare these results with those that are predicated through theoretical analysis and design.

Mr. Durkin, this is consistent in principle with part of your own proposed legislation calling for a 2-year—a voluntary 2-year pilot program to test the cost and feasibility of implementing the standards.

You point out that the pilot program would provide information on what resources States and local governments will need to implement BEPS and on the cost effectiveness of the standards.

It is inconceivable, you went on to say, that Congress would even consider imposing standards that had never been tried on a pilot basis.

Now, NIBS does not believe that the schedule suggested by DOE, when its representative appeared before your subcommittee earlier this month when, for example, reproposal of the standards and implementation regs were suggested for February 1981 and final promulgation by August 1981, is one that can be maintained and still produce the desired results.

Clearly, there is an extensive number of activities that must take place before the standards are reproposed. Many of the tasks to be performed are interdependent and, thus, must be carried out sequentially.

Furthermore, in light of the serious defects in the currently proposed standards and underlying data base, NIBS believes another publication of ill-conceived standards developed without broad building community input would deal a serious blow to all future efforts strongly supported by NIBS to design and construct energy-saving buildings and to foster the use of performance standards in buildings, a congressional mandate.

NIBS believes that such standards can be made to work and would be embraced nationwide, particularly if the Nation's building community considered in the broadest sense of the word participates in the process.

NIBS stands ready to help. Thank you for the opportunity to be here today.

Senator DURKIN. Thank you.

[The prepared statement of Mr. Newman follows:]

June 26, 1980

Statement
of the
National Institute of Building Sciences
before the
Subcommittee on Energy Regulation
Committee on Energy and Natural Resources
United States Senate
concerning
Building Energy Performance Standards (BEPS)

Mr. Chairman and Members of the Subcommittee. My name is Joseph H. Newman. I am Chairman of the Board of the National Institute of Building Sciences, more popularly known by its acronym, NIBS. We welcome this opportunity to appear before the Subcommittee, not only because of the specific mission established for NIBS with respect to BEPS in the Energy Conservation and Production Act of 1976, but because of the broader mission established for NIBS in its own authorizing legislation, Public Law 93-383.

NIBS was created to serve as an authoritative national source to make findings and to advise both the public and private sectors on the use of building science and technology in achieving nationally acceptable criteria and standards--particularly performance criteria and standards--for use in Federal, State, and local housing and building regulations. Further, in the NIBS authorizing legislation, Federal agencies are encouraged by the Congress to accept the technical findings of NIBS.

NIBS is a unique organization, working each day to resolve differences among the many diverse elements of the housing and building community and on behalf of the public, through a voluntary consensus process and in a way that brings representation from all the interests, including consumers--as required by its enabling legislation. The intent was to avoid the very kind of divisiveness that has been created by BEPS. What we are proposing today, as a result of that process, is a course of action which we believe will put the BEPS program on a sound and productive track, based on cooperation rather than confrontation. The NIBS' approach lets the constituencies of the Congress do most of the work on a voluntary basis and encourages the building community to solve its own problems. This reduces emotionally-based decisions, helps elicit the best from people, and reduces the cost of Government involvement. Most importantly, it gets the job done.

Unquestionably, design standards for energy conservation in buildings are important to the nation's energy conservation efforts. However, it must be recognized that their development in a performance mode, and their promulgation by the Federal Government, are quite unique in the field of housing and building. Therefore, if the program is to produce the desired results, not only must the standards be technically sound, but the manner in which they are created, promulgated, and implemented must be such that they will work within the immensely complex housing and building regulatory structure that already exists at all levels of government.

NIBS' Participation in the Proposed BEPS

The Energy Conservation and Production Act of 1976 directed the Federal agency developing building energy performance standards (then HUD and now DOE) to contract for the services of NIBS as a consultant in developing those standards. Furthermore, the subsequent review and update of the standards required by the Act is to be conducted in consultation with NIBS. Finally, the Act requires that NIBS serve as the vehicle for building community input into

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the entire BEPS development and implementation process. The term "building community" means all participants in the housing and building process, both public and private, including consumers, labor, model code bodies, regulators, designers, builders and contractors, manufacturers, suppliers, and many more. That is precisely the constituency of NIBS and the NIBS' Consultative Council that was provided for in the NIBS' enabling act and from which we believe the Congress intended NIBS to derive a large measure of its authoritativeness. The NIBS Consultative Council today, has nearly 300 organizational members and more than 650 individual participants. The organization members in turn represent literally hundreds of thousands of additional individuals, large and small businesses, and institutions, both public and private.

Unfortunately, NIBS' participation in the evolution of BEPS was substantially more limited than we believe the statute contemplated and the building community and NIBS expected. NIBS simply was not allowed to become involved in a substantive way early enough to function as a facilitator and coordinator of input from the broad-based building community--i.e., input that would have been useful in developing a proposed BEPS that would be practical and responsive to the objectives of the 1976 Act.

Since the 1976 Act and indeed since the oil embargo, the housing and building community has not been idle, nor have State and local governments. Much has been accomplished and the impetus provided by the Congress has been a significant factor. The individual consumer and the building owner/user also have put demands on the building community to perform. Therefore, we have come a long way in the intervening 4 to 6 years. What is needed now is not emergency actions but a sound cooperative effort in which consumers, the building industry, and government at all levels, pull together to set and then meet progressively higher performance goals.

The centerpiece of NIBS participation in BEPS and in its effort to bring about this cooperative effort, is its April 30, 1980 report to the Department of Energy in response to the Department's November, 1979 Notice of Proposed Rulemaking. We request that this report of NIBS and the accompanying press release be included in the Subcommittee's hearing record.

The NIBS' report is the product of a thorough study and of extensive participation of a broad range of disciplines and interests that make up the nation's building community. In addition to participation of the NIBS' Consultative Council, NIBS assembled a body of technical experts, convened 10 regional workshops to explain and then elicit comments on BEPS, and held two major open-participation conferences in Washington. Because of those activities in which NIBS was able to bring together so many representatives of the many and diverse elements of the building community, NIBS believes its report fairly portrays the collective views of all concerned, even though individual elements of the building community feel compelled--and rightly so--to express their own opinions on the future course of BEPS.

Regarding the Proposed BEPS

NIBS has concluded that the BEPS have such serious problems and so many deficiencies that it is inadvisable to proceed with the currently scheduled promulgation date. In our view, neither the Design Energy Budgets (DEBs) nor the Standard Evaluation Technique (SET) presently satisfy the basic requirements of a performance standard--i.e., unambiguous, reasonable, and measurable performance goals, and a measurement technique for determining compliance that is creditable, understandable, readily applicable, and capable of producing consistent and realistic results. A performance standard should stimulate, not limit or constrain, innovation. We do not believe that BEPS in its present form meets these tests and, therefore, will not serve the ends envisaged by the

Congress in creating the BEPS program--i.e., positive, innovative actions to conserve energy in new housing and buildings.

Therefore, NIBS recommends that the legislatively mandated promulgation date of August 14, 1980, be deferred until the technical and structural defects in the standards are corrected and revised proposed standards are published and subjected to review and comment. Additionally, the Institute recommends that concurrent with refinement of the proposed standards, an implementation strategy and proposed implementation regulations be developed. Those regulations should be published at the same time as the new proposed standards; for, in our view, producing standards without the means for introducing them into the mainstream of the building regulatory system will seriously jeopardize the total effort. Further, before the process of revising the proposed standards and developing implementation regulations starts, NIBS believes that the building community should be afforded the opportunity to contribute to formulation of the plan of research and other contemplated work.

With respect to the matter of facilitating acceptance of the standards once developed and published, NIBS recommends that the building community, which includes State and local regulatory agencies, be given ample time to adopt to the standards on a voluntary basis. Two years would seem to be a minimum period, because, not only will it take this long to demonstrate the efficacy of the standards and work out any bugs, but several States still have biennial or truncated legislative sessions every other year. To that end, NIBS recommended in its report that incentives and other assistance be provided: to enable States that have adopted building energy conservation standards to update and strengthen them and bring them into equivalency with BEPS; to enable jurisdictions that do not yet have such standards to adopt them immediately and work toward equivalency; and to educate and train building code officials, design professionals, builders and contractors, and other building community participants in use of standards and particularly performance standards, including BEPS. Grants to the States, and grants or contracts to appropriate private institutions, would entail an expenditure of perhaps $6 to $10 million dollars per year over a two- to three-year period.

A Timetable for Implementing the Institute's Recommendations

The proposed Housing and Community Development Act of 1981 contains an amendment to the Energy Conservation and Production Act that would delay the promulgation date of final standards for up to two years--i.e., until August, 1982. That proposal has been a source of much discussion within and outside Government, and has occasioned several requests for NIBS advice from both the Legislative and Executive Branches on a time schedule within which the goals of BEPS can realistically be achieved. Such inquiries have led NIBS to recommend the following schedule for developing, promulgating, and implementing workable standards--standards that will result in the hoped-for energy savings in new buildings:

1. A combined Notice of Proposed Rulemaking for the Standards and their implementing regulations by June, 1981, one year from now, allowing time for planning and carrying-out the needed work on BEPS in close consultation with the building community.
2. A 60-day public comment period, which should be sufficient if the building community has been consulted to the maximum extent practicable during revision of the proposed standards.
3. Publication of final standards and their implementing regulations no later than December, 1981, giving DOE approximately 4 months to make

any needed revisions in response to the public comments on the proposed standards and implementing regulations.

4. A 2-year period for voluntary compliance with the standards, during which State and local governments would be encouraged to adopt and implement BEPS and/or adopt or upgrade existing or other standards to equal or exceed the BEPS performance levels, with a program of incentives, and education and training aids, implemented in conjunction with NIBS.
5. At the conclusion of the 2-year, voluntary compliance period--i.e., by the end of 1983--the impact of the program should be assessed and a determination made as to the necessity of making the standards mandatory. At that time there would be a report filed with the Congress that could form a basis for that decision within the 90-day period.

In summary, the three principal elements of our suggested timetable are: full participation by NIBS and thus the nation's building community, in all stages of the BEPS process as originally intended by the 1976 Act; an opportunity for voluntary adoption by states and their political subdivisions of BEPS, or other standards which by the end of the voluntary compliance period will equal or exceed BEPS, and an assessment of the results before imposing sanctions; and, an active program of incentives and education and training to facilitate voluntary compliance.

Verification of Actual Performance

The additional time for standards refinement provided by the NIBS' timetable, would provide an opportunity for all concerned to ascertain the actual performance of buildings, through demonstrations or otherwise, that are constructed in accordance with the requirements of BEPS or their equivalent, and to compare these results with those that are predicted through theoretical analysis and design. Such a process would, in the NIBS view, mitigate the potential for liability problems which design professionals face--and possibly State and local regulatory enforcement agencies as well--in being required to certify that buildings comply with BEPS without any real knowledge of whether actual performance from a fuel-consumption standpoint will compare reasonably with that which is predicted in design.

Comment on DOE Timetable

NIBS does not believe that the schedule suggested by DOE, when its representative appeared before your Subcommittee earlier this month--when, for example, reproposal of the standards and implementation regulations were suggested for February, 1981 and final promulgation by August, 1981--is one that can be maintained and still produce the desired products. Clearly, there is an extensive number of activities that must take place before the standards are reproposed. Many of the tasks to be performed are interdependent and thus must be carried-out sequentially. Computer programs must be perfected before performance standards are developed; such standards must be perfected before ASHRAE 90-75R can be adjusted; and all of the foregoing must take place before a simplified manual of accepted practice--a "cookbook"--and other alternative approaches can be drafted.

While NIBS subscribes to the urgency of the situation with respect to conserving energy in new buildings, based on our own experience with the program and conversations with DOE staff at the working level, we believe that 18 months is the minimum time that will be required to put BEPS into a form that will be usable by the building community and to, at the same time, set forth the necessary implementation strategy and regulations.

Furthermore, in light of the serious defects in the currently proposed standards and underlying data base, NIBS believes another publication of ill-conceived standards, developed without broad building community input, could deal a serious blow to all future efforts, strongly supported by NIBS, to design and construct energy-saving buildings and to foster the use of performance standards in building--a Congressional mandate. Indeed, the intense controversy that has swirled about the proceedings within the Congress itself as it seeks to find the proper course to follow from this point forward, is clear evidence of the damage that can be done by artificial timetables and failure to take full advantage of all the talents our country offers.

Conclusions

The foregoing is merely illustrative of some of the critical issues that must be addressed and that are detailed in the NIBS report. As stated at the outset in its report, NIBS supports the development of energy performance standards. NIBS believes that such standards can be made to work and would be embraced nationwide, particularly if the nation's building community, considered in the broadest sense of the word, participates in the process. NIBS stands ready to perform its statutory function of coordinator of that participation and as advisor to the Congress and the Executive Branch.

Thank you for this opportunity to appear.

Senator **Durkin**. Don't you think, though, that before you will achieve acceptance around the country that, some place, we are going to have to see that it works and it is not just a creation of Washington; that it actually works?

Mr. **Newman**. There is no question. The key to credibility of any regulation is the confidence that the regulated has in the regulation.

And if the regulated becomes a part of the process and if the regulated has an opportunity to test, without sanctions, without the onus of being—without the problems that inevitably would come up in an untested regulation, then I believe very strongly that the consumer, that the user, that the owner will play ball.

Senator **Durkin**. My concern is that this may be implemented hastily and actually be counterproductive, and that it will postpone energy conservation in the long run.

You stated in your testimony that you were not allowed to become involved early enough. Could you elaborate on that, and did you ask for greater participation? Why do you think you were unable to participate as much as you felt it was necessary?

Mr. **Newman**. I think that there are many reasons. One of the reasons, I think, is that DOE perceived that NIBS was still in its infancy and, therefore, did not have the access to entire building community because its consultative council, as required by the legislation, was not fully organized.

This was in spite of the fact that NIBS did have access to the building community in an informal way.

I think another reason is that DOE had not got its act together.

Senator **Durkin**. Is there any evidence that they have? [Laughter.]

We will leave the record open for any evidence you have along that line.

Mr. **Newman**. I would say, today, in the limited sense of BEPS, that much of the activity that has taken place in the last several months show evidence of vast improvement.

The real question is that it took a long time for DOE to come to the point to reach some of its deliberations.

There is another issue, and that has to do with—I am not sure of the exact name of the act—and that is the conflict--the apparent conflict that exist in the NIBS legislation—or, the perceived conflict that exists in the NIBS legislation and in other legislation concerning whether or not NIBS is really—can be a party to the promulgation and development of the regulations.

There is a question having to do with the Freedom of Information Act; what information we are entitled to during development of the regulations and our participation.

We can be perceived to be just one of the other boys on the street, or we could be perceived to be as intended by the Congress.

I think that is part of the problem.

Senator **Durkin**. Dr. Cooper?

STATEMENT OF DR. MARK N. COOPER, DIRECTOR OF RESEARCH, CONSUMER ENERGY COUNCIL OF AMERICA

Dr. COOPER. My name is Dr. Mark Cooper. I am director of research of the Consumer Energy Council of America.

CECA is a broad-based coalition of national consumer, labor, farm, public power, rural electric cooperative, urban minority and senior citizen organizations established to represent the consumer in national energy policy debate.

CECA has been involved in the rulemaking for BEPS for over 1 year, and has undertaken a major research effort to analyze the BEPS program.

I am pleased to be here today to present some of the results.

Because of time limitations, I will only touch on a few highlights.

I am submitting a full text of my statement and our report and hope that they will be made part of the record.[1]

Senator DURKIN. Without objection, they will.

Dr. COOPER. CECA supports mandatory standards to regulate energy use in buildings and the performance principle for those standards.

We take very seriously the strong language that Congress used to mandate development of standards designed to achieve maximum practicable improvement in energy efficiency and increases in the use of nondepletable resources of energy.

We believe the Nation must do the utmost to conserve energy. And we commend the Department of Energy for its efforts to deal with such a large and complex issue.

We feel, however, that DOE has been much too timid in pursuing the goal of conservation, and we urge Congress to follow through on the strong stand that it took in favor of conservation when it passed the Energy Conservation and Production Act of 1976.

My remarks today are intended to point out just how important conservation in new buildings is to the consumer and the Nation and why this conservation must be achieved through a dynamic and aggressive BEPS program.

As part of our report, we have conducted an extensive review of major national energy policy studies. And we conclude that conservation in buildings can easily add more to national energy resources than other conservation options, than most production options, such as synthetic fuels and biomass, and about as much as much as nuclear energy or coal.

In spite of these enormous potential benefits which BEPS promises, there are critics who would endlessly delay or otherwise kill the program.

From the standpoint of energy conservation, a delay in the program can have major consequences which must not be underestimated.

A 3-year delay could waste the equivalent of 200 million barrels of oil by 1990.

Senator DURKIN. Doctor, if I could interrupt just a second, I think we are all interested in energy conservation. I know I have spent as much time as anyone in the Senate fighting for it.

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[1] See appendix VI.

I don't like the word "conservation." I would rather use the phrase "energy efficiency."

But how do you think that a program that does not have the general support and may well not have been thoroughly thought out is going to save any energy?

Dr. COOPER. As part of our recommendations, we agree that a certain amount of time is necessary to get the program in order.

We also, in agreement with your suggestions in the bill you propose, agree that more support within the administration is necessary in order to get the program up and running.

We believe, however, that there must be a balance between taking a long time, which permits the construction of inefficient buildings, and gaining the support and getting the research and principles and organization of the programs modified.

So that we would like to see a balance. And we hear constantly about the problems and the need for delay. We would like to emphasize the importance of getting the program up to speed.

Investment in conservation will not only greatly enhance the value of the single largest investment that the average consumer makes—one's home—but it will also yield rich and rapid economic returns.

Many thousands of dollars can be saved over the life of a mortgage without imposing any serious financial burden on the consumer.

On the other hand, the unfortunate purchaser of energy inefficient buildings, perhaps during a delay period, can expect to pay between $300 and $1,000, in current dollars, more for energy in the first 5 years than if BEPS had been enforced.

These excessive costs and wasted energy just keep adding up.

We recognize the inadequacies of the basic research conducted by DOE, but we also recognize that research in any complex sociotechnical area will always remain imperfect.

And we believe that a sufficient base has been established so that, with a little more time, DOE can easily proceed with the program.

Moreover, CECA has moved beyond simple criticism to explore the specific areas that need to be reinforced in the research.

And one general conclusion can be reached: Careful rethinking of the research almost invariably leads to more conservation not less.

As members of the committee review the scatter shot, broadside criticism hurled at DOE's BEPS research, I urge you to examine each individual attack and follow it to its logical conclusion.

Upon careful scrutiny, what looks like a devastating indictment turns out to be a call for more conservation through regulation.

In my testimony, I develop an example which is the Council on Wage and Price Stability's comments on BEPS filed on behalf of the Regulatory Analysis Review Group.[1]

It seems to me that COWPS has made three errors in its argument.

First, it points out that better energy conservation techniques are being applied in new construction. And that is the case.

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[1] These comments are reproduced in the appendix VII.

However, the evidence that it uses to support this point shows that two-thirds of the buildings constructed in 1977 were, in fact, suboptimal, given the prevailing conditions.

What COWPS has done is mistakenly and unjustifiably replaced the concept of simple change for Congress stronger and more appropriate call for maximum practicable improvement.

Second, COWPS argues that, with some success, DOE has been encouraging States and localities to adopt other energy standards.

Yes, the BEPS program is fundamentally committed to a consolidation and upgrading of the programs such as these which, as a GAO report suggests, have been limping along at best.

Finally, COWPS argues that increasing energy prices coupled with educational efforts to overcome market myopia will do the job.

Yet, the National Academy of Sciences, the Harvard Business School, Resources for the Future and the Ford Foundation, each of which embrace basic market approaches to conservation, have all examined the housing market and potential effects of prices and education on conservation, and they have all concluded that regulation of energy efficiency in the building sector is necessary.

This was Congress original judgment, and we believe it is clearly superior to that of COWPS.

Thus, I urge great care in evaluating the criticism of the BEPS program and DOE's research.

We have endeavored to exercise this care in our review of DOE's approach to the program, especially those factors which have led it to mandate less conservation than is appropriate.

And there are a number of areas in which we find the research wanting.

DOE's analysis of BEPS underestimated the present value of fuels by as much as 200 percent and, thereby, dramatically, underestimated the value of energy conservation.

DOE's analysis of solar energy is also entirely inadequate because its assumptions and basic approach work directly against the inclusion of solar energy.

A proper economic analysis——

Senator **Durkin**. Doctor, let me just ask a question. If they have been so inaccurate in that laundry list that you have—and I agree with you—are we to believe that they have assigned their best people to this program. Aren't we going to continue to run into the same problem?

Dr. **Cooper**. Well, there are two responses to that. One is that we have done an awful lot of research intended to shore up those points where DOE has been weak so that, if we review the entire comment record, I think we will find clear examples of how to proceed and the proper approach to be taken.

Second of all, they have clearly been understaffed. And as one of our major recommendations, we strongly urge that the Department and the administration make a firm commitment to this program to execute the research.

This type of research—the economic analysis, at any rate, is not that difficult.

We would agree that implementation and so forth are more complex problems. But we think you have to start from a firm basis of technical and economic analysis.

In addition, DOE has detracted from the program in other ways.

In utilizing weighting factors, DOE has added complexity, created a clash of powerful industrial interests that would otherwise be tangential to the program, contradicted national energy policy and focused the whole program on fuels instead of building.

CECA believes that BEPS should focus on the building shell, which is the aspect of the building least likely to change and optimize its energy-consuming characteristics over the long term.

It should leave the establishment of national fuel policy to some other program.

Finally, by failing to issue an implementation rule simultaneously with publication of the standards, DOE has made it extremely difficult to assess the effectiveness of the program.

DOE has offered some glimpses of its approach to implementation, and we are concerned that it intends to rely on a methodology which is entirely too complex, especially for residences and other small buildings.

On the basis of our criticism, CECA has outlined an alternative approach to BEPS and set out a detailed scenario for the next 20 years.

Taking all factors into account, CECA finds that neither technology nor economics present real constraints to energy conservation, and any problems of practicability are likely to be resolved over time.

Therefore, we recommend periodic upgrading of the standards.

Under CECA's scenario, we project that, by the year of 2000, the average house can be built to use energy at the level at which superefficient houses consume energy today.

The savings in the year 2000 would be roughly the equivalent of 2.7 million barrels per day of oil and, over the next 20 years, something on the order of 5 billion barrels equivalent of oil.

In the short term, CECA believes that the overall program would be best served if Congress would grant DOE a short, 6-month delay in issuing the final rule.

During this time, the implementation rule should be completed. Simultaneously, the budget-setting rules should be reworked.

This should include the elimination of weighting factors, the calculation of equivalences between BEPS and current prescriptive codes, the preparation of manuals of recommended practice and a reassessment of the various decisions and data bases which led energy budgets to be set too high.

In order to insure that these goals are met, CECA recommends a number of steps be taken.

DOE should form a research advisory group representing all of the constituencies which are vitally affected by the BEPS program.

Congress should require DOE to establish an explicit timetable for achieving specific research and implementation goals.

It should transfer ultimate authority for the program from the Department of Housing and Urban Development to the Department of Energy so that a coordinated program will be possible and so that an adequate commitment of personnel can be made.

This must be coupled with a firm commitment at the highest levels of the Department and the administration to provide the program with the resources necessary to make it effective.

Once the final rule is promulgated, DOE should adhere to the currently mandated procedure of allowing a 1-year period for full implementation.

In that year, DOE can gain significant large-scale experience with the program, through voluntary compliance, educational efforts and funded demonstration projects.

And the decision to impose sanctions can be made at the end of that year, rather than the beginning.

In conclusion, I would like to stress the serious consequences of any unnecessary delay in moving forward with the BEPS program.

Each day of delay allows the construction of as many as 6,000 energy inefficient housing units and as much as 6 million square feet of commercial floor space, all of which may be obsolete before it is occupied.

In 1976 when Congress mandated BEPS, America's energy future looked bleak, and Congress rightly judged that conservation in new buildings could contribute significantly to improving that future.

Today, when our energy future looks a great deal bleaker, that initial response is even more appropriate.

Now is not the time to back down on the commitment that Congress made to conservation.

Congress should permit neither foot-dragging bureaucrats nor a recalcitrant industry to jeopardize the Nation's energy future by undermining a positive, productive and important conservation program such as BEPS.

Thank you. And I would be happy to answer any questions.

Senator DURKIN. Thank you.

[The prepared statement of Dr. Cooper follows:]

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TESTIMONY

OF

DR. MARK N. COOPER

DIRECTOR OF RESEARCH

CONSUMER ENERGY COUNCIL OF AMERICA

BEFORE THE

SUBCOMMITTEE ON ENERGY REGULATION

OF THE

COMMITTEE ON

ENERGY AND N'TURAL RESOURCES

UNITED STATES SENATE

ON THE

DEPARTMENT OF ENERGY'S

BUILDING ENERGY PERFORMANCE STANDARDS

June 26, 1980

Mr. Chairman and Members of the Committee:

My name is Dr. Mark Cooper. I am Director of Research for the Consumer Energy Council of America (CECA). CECA is a broad-based coalition of major national consumer, labor, farm, public power, rural electric cooperative, urban, minority and senior citizen organizations established to represent the consumer viewpoint in the energy policy debates before Congress, the Administration and other public forums. I appreciate the opportunity to appear before you today.

CECA has been actively involved in the Department of Energy's (DOE) rulemaking process on Building Energy Performance Standards (BEPS) for over a year under a grant from DOE. CECA's efforts have included two sets of activities. One set involved disseminating information about the BEPS program to the general public. Through letters, telephone conversations and a series of educational seminars conducted across the country -- in Washington, D.C., Boston, New York, Atlanta, Minneapolis, Des Moines and San Francisco, we have had a lively exchange of information and ideas with several hundred consumers as well as industry groups. This type of public contact, which few, if any, other organizations have experienced, has given us a close understanding of the public's attitude toward energy conservation in new buildings.

The second set of activities involved a major research effort to analyze the BEPS program. I am pleased to be here today to present the results of that effort. Because of time limitations, I will touch on only a few highlights of our analysis. I am also submitting the full text of our report on the BEPS program, entitled "Energy Conservation in New Buildings: A Critique and Alternative Approach to the Department of Energy's Building Energy Performance Standards." I respectfully request that this report become part of the hearing record.

CECA supports both mandatory standards to regulate energy use in new buildings and performance principles for those standards. We take very seriously the strong language that Congress used in mandating the development of standards "designed to achieve maximum practicable improvement in energy efficiency and increases in the use of nondepletable sources of energy." We believe that the Nation must do the utmost to conserve energy and we commend the Department of Energy for its efforts to deal with such a large and complex issue as energy use in buildings.

We feel, however, that DOE has been much too timid in pursuing the goal of conservation. We would argue most vigorously, as Deputy Secretary of Energy John Sawhill suggested recently on the Op-Ed page of the New York Times, that this is the critical moment for Americans to be aggressive and decisive in our energy conservation efforts. Unfortunately, while the Administration puts gargantuan efforts into foisting on the American people such ineffective, absurd and regressive policies as a 10 cent a gallon import fee -- in the name of conservation -- we have yet to see it make an equal public commitment and media campaign in favor of positive, effective conservation programs such as BEPS.

Fortunately, Congress has had the vision to see through the import fee hoax. Equally fortunately, Congress took a strong stand in favor of conservation when it passed the Energy Conservation and

Production Act in 1976 (ECPA). I urge you to follow through on that stand and not grant any unwarranted and damaging delay in the start-up of the BEPS program.

My remarks today are intended to point out just how important conservation in new buildings is to the consumer and the Nation and why this conservation must be achieved through as dynamic and aggressive a BEPS program as possible.

THE IMPORTANCE OF BEPS FOR ENERGY CONSERVATION

1. National Energy Savings

We can best begin to appreciate the importance of the BEPS program by understanding the contribution it can make to national energy resources. CECA has conducted an extensive review of a number of major national energy policy studies published in the last year or two and findsthat conservation in buildings can easily add more to national energy resources than other conservation options, more than most production options, such as synthetic fuels and biomass, and about as much as nuclear energy or coal. Table I shows this contribution very dramatically.

The national studies' estimates of the potential contribution of new buildings for the year 2000 range from about 5 quads (or the equivalent of 2.3 million barrels of oil per day) to 12 quads (or the equivalent of about 5.6 million barrels of oil per day). This range of energy savings is greater than four of the ten production options and equal to the average of all production options. These additions to national energy resources resulting from conservation in new buildings are technologically more certain, environmentally more salutary and economically more justified than any other national energy policy options.

In spite of the enormous potential which BEPS promises, there are critics -- particularly from the construction industry -- who would endlessly delay or otherwise kill the program. From the standpoint of energy conservation, a delay in the program can have major consequences which must not be underestimated. To begin with, we should keep in mind that ECPA provides for a year of preparation prior to implementation, so that even if the final rule were promulgated on August 14, 1980, as mandated by Congress, the program would not go into effect until August 1981. The amendments to the HUD authorization bill recently passed by the Senate and House Banking Committees, which call for up to two years' additional delay for promulgation alone, would mean that implementation might not go into effect until mid-1983.

In the next three years, between 3 and 6 million housing units will be built and an equal amount of commercial floor space will be constructed. Even if all of this construction conforms to minimum energy guidelines currently in force in some (though not all) states (HUD Minimum Property Standards for residential construction and ASHRAE 90-75 for commercial buildings), these buildings would be obsolete before they are occupied. On the basis of design calculations, this stock of inefficient buildings will waste the equivalent of between 12 and 24 million barrels of oil per year more energy than if constructed to comply with BEPS as formulated by DOE.* From now to 1990, between 100 and 200 million barrels of oil equivalent would be wasted in this building stock. If BEPS were set at a realistically strict level such as the one CECA recommends, the annual savings in 1990 could be as much as 70 million barrels and the cumulative savings between now and 1990 would be more than 500 million barrels. That energy can never be recovered. Retrofitting those buildings to improve their energy efficiency sometime in the future will cost a great deal more than constructing energy efficient buildings in the first place.

2. The Benefit to the Individual Consumer

The benefit of the BEPS program must not be measured only in terms of national energy savings. An aggressive BEPS program is also clearly in the best interest of the individual consumer. CECA has conducted a careful and exhaustive analysis of the economics of energy conservation and we have shown, beyond any doubt, that investment in conservation will not only greatly enhance the value of the single largest investment that the average consumer makes -- one's home -- but it will also yield rich economic returns.

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* The BEPS analysis shows that residences constructed to comply with nominal BEPS consume 11 million BTUs less, on average, than buildings constructed to lenient BEPS (which are roughly equal to HUD-MPS). That is roughly equivalent to 2 barrels of oil per home. We can assume that roughly the same relationship holds for commercial buildings. Alternatively, one can use the difference in energy savings between loose budgets and nominal budgets in 1985 (which is three years after full compliance with each) to estimate the energy that would be wasted. This number is roughly equivalent to 27 million barrels per year. The difference stems from the fact that DOE's estimates of construction activity are quite high.

Simply put, the BEPS program is founded on a positive, constructive type of conservation, as opposed to simple deprivation. It materially improves the assets of the individual and the capital stock of the Nation, while saving large amounts of energy and not affecting life styles.

For example, if energy budgets were set at the level that CECA recommends, the homeowner in colder climates (6000 degree days) could save between $5,600 and $21,000 in fuel bills (depending on the fuel used and discounting all values to the present at 3%) over the 30 year life of a mortgage. Depending on the conservation strategy chosen, the necessary investment would be in the range of $1,600 to $3,200. This is the range for the low infiltration approach using costs equal to and twice as great as DOE's estimates. With normal financing arrangements, positive cash-flow would certainly occur in less than three years and might occur in as little as one year. That is, within three years the savings in energy bills is greater than the increase in mortgage payments and everything thereafter is gravy.

The costs to the individual consumer of delaying the BEPS program can also be easily calculated. The unfortunate purchaser of the energy inefficient house built during the delay period can expect to pay between $55 and $170 more for energy in the first year than if BEPS had been in force. In the first five years the consumer would pay between $330 and $1,400 (in current dollars) more for energy. The excessive costs and wasted energy just keep adding up over the years. And that same unfortunate purchaser may, a few years hence, have as much trouble selling an energy inefficient house as auto owners have selling gas-guzzlers today.

DIFFICULTIES IN THE BEPS PROGRAM

CECA believes that these benefits to the Nation and the consumer are so compelling that they outweigh the difficulties related to the program. Because CECA has also examined the difficulties carefully, we are convinced that they can be overcome with deliberate speed.

We recognize the inadequacies of the basic research conducted by DOE. There are inconsistencies in assumptions; there are major areas that have not been fully investigated; there are undocumented decisions; and there are peculiar, if not outright incorrect choices of variables. A full list of the specifics would fill a volume (it has, ours), but research in any complex sociotechnical area will always remain imperfect and we believe that a sufficient base has been laid so that, with only a little more time, DOE can easily proceed with the program.

Moreover, CECA has gone beyond mere criticism to explore the specific areas that need to be reinforced in the research. One general conclusion can be reached. Careful rethinking of the research almost invariably leads to more, not less, conservation.

1. A Note of Caution on Public Criticism of the Basic Research

As the members of the Committee review the scatter-shot broadsides criticism hurled at DOE's BEPS research, I urge you to examine each individual attack and follow it to its logical conclusion. Upon careful scrutiny, what looks like a devastating indictment turns out to be undeniably a call for more conservation through regulation -- not a call to scrap the program.

a. The Flaws in the COWPS Criticism

Let me take one important and widely publicized example: the Council on Wage and Price Stability (COWPS) comment on BEPS filed on behalf of the Regulatory Analysis Review Group (RARG). COWPS cites three basic reasons for abandoning or delaying the BEPS program:

First, COWPS points out that "better energy conservation techniques are being applied in new construction." As evidence it cites a National Association of Home Builders study which shows that, in 1977, 28% of new residences used ceiling insulation with an R value of 30 or greater. COWPS failed to point out, however, that the BEPS research basically reflected 1977 conditions and that the research concluded that well over 90% of buildings should have been constructed with ceiling insulation with an R value of 30 or greater. In other words, close to two-thirds of the buildings constructed in 1977 were suboptimal on this most basic and important energy conserving feature.

No doubt the industry will continue to respond to changing circumstances, but it is equally certain that the response will be suboptimal and it will be especially slow in adopting innovative conservation approaches, such as the use of solar energy, a use which is one of the main objectives of the BEPS program. COWPS has mistakenly replaced mere change for Congress' stronger and more appropriate call for "maximum practicable improvement."

Second, COWPS argues that "with some success, DOE has been encouraging states and localities to adopt" other energy standards, such as ASHRAE 90-75. Yet, the BEPS program is fundamentally committed to a consolidation and upgrading of programs such as these, which have been merely limping along. As noted above, these programs are inadequate from the point of view of the energy savings that they can achieve. Further, as a study by the Comptroller General has shown, they have been far from compelling in achieving even those meager energy savings.

Finally, COWPS argues that increasing prices, coupled with educational efforts to overcome market myopia, will do the job. Yet, the National Academy of Sciences, the Harvard Business School, Resources for the Future and the Ford Foundation, each of which embrace basic market approaches to conservation, have all examined the housing market and the potential effects of prices and education on conservation and they have all concluded that regulation of energy efficiency in the building sector is necessary. COWPS laments the fact that DOE did not choose to question Congress' judgment that mandatory building energy performance standards are necessary and it urges DOE to do so by conducting research into the conclusions that led Congress to mandate BEPS. However, when DOE stands firmly behind Congress' decision to require BEPS, it clearly stands in the company of major institutions that have recently studied the problem and reached the same conclusion as Congress.

Thus, I urge great care in evaluating the criticism of the BEPS program and DOE's research.

2. Specific Flaws Identified by CECA in the Program

CECA has endeavored to exercise extreme care in its review of DOE's approach to the program, especially those factors which have led it to mandate less conservation than is appropriate.

a. Fuel Price Estimates

DOE's analyses of BEPS underestimated the present value of fuels by as much as 200% and thereby dramatically underestimated the value of energy conservation. This grotesque miscalculation offsets any underestimation of the cost of conservation. In fact, it renders cost-justified a wide range of conservation approaches which DOE excluded from the final energy budget setting (either by assumption or on the basis of faulty economic analysis). A full economic analysis, with more realistic estimates of costs and benefits and no constraints on the conservation options analyzed, such as that attempted by CECA in our report, will lead to a great deal more conservation being mandated.

b. Solar Energy

DOE's analysis of solar energy is also entirely inadequate. DOE's assumptions and basic approach work directly against the use of solar energy. For instance, DOE's analysis was performed with thermostats set too high at night, thus making conventional fuels appear more important than they need be. The shading coefficients are set so that during the winter solar energy is wasted and during the summer solar energy increases cooling loads unnecessarily. The net effect is to make solar energy appear less effective than it actually is.

Internal heat generated from both appliances and from occupants is assumed to be so unrealistically high that it exhausts the potential solar absorptive capacity of the house. DOE's decision to preclude mechanical devices, especially night-insulating shutters, restricts the potential contribution of solar. The decision to assume that every house has central air conditioning forces one to assume that it has duct work, even where solar renders a small baseboard heating system adequate. This assumed cost of installing duct work reduces the cost competitiveness of solar.

The solar analysis has failed to start from the logical point -- incorporating all free passive solar. It has failed to consider the most logical combination -- free passive solar plus active solar hot water heating. And it has failed to include solar energy in an overall economic analysis. A proper analysis of solar energy -- one that sets it on an equal footing with conventional approaches to conservation -- will lead BEPS to stipulate more conservation.

c. Weighting Factors

In utilizing weighting factors DOE has seriously detracted from the BEPS program by focusing the program around the wrong variable, by adding complexity and by creating a clash of powerful industrial interests that would otherwise be tangential to the program. Weighting factors were not specified by Congress in mandating BEPS and they are contradictory to current national energy policy.

Weighting factors force the optimization of the whole program around the wrong variable -- relative fuel prices. Relative fuel prices are highly unstable. Indeed, natural gas prices are rapidly approaching BTU equivalency with imported oil. Yet, BEPS encourages the use of gas and allows a building using natural gas to be constructed less efficiently than a building using electricity. Further, since fuel systems change two or three times over the real life of the average building, a gas building (which could be constructed relatively inefficiently according to BEPS), if converted to electricity, would result in a tragic waste of resources. In fact, it would result in a waste of gas in the first instance. There is nothing heroic in placing a lesser premium on wasting one dwindling fossil fuel over another.

CECA believes that BEPS should focus on the building shell, which is the aspect of the building least likely to change and optimize its energy consuming characteristics over the long term. If DOE focused on the central concern of the program, requiring energy efficient buildings, rather than setting policy regarding fuels, the program would be greatly simplified and resistance to it would be markedly reduced. We therefore recommend that weighting factors be abandoned altogether and that the establishment of national fuel policy be left to some other program.

d. Implementation

By failing to issue an implementation rule simultaneously with publication of the standards, DOE has made it extremely difficult to assess the full effectiveness of the program. DOE has offered some glimpses of its approach to implementation and we are troubled that these glimpses suggest that DOE intends to rely on a methodology which is entirely too complex, especially for residences and other small buildings.

While a performance option for meeting BEPS must be maintained, in order to simplify the implementation process DOE must update existing prescriptive codes, to be equivalent with BEPS; provide a series of precalculated tables which enable builders to easily compare a large variety of energy-saving options in complying with BEPS; and issue manuals of recommended practices which incorporate model buildings that meet BEPS. The task of working out these implementation tools is large, but it is a straightforward task for which examples already exist and it can be accomplished in a fairly short period of time.

A SENSIBLE STRATEGY FOR THE BEPS PROGRAM: CECA'S RECOMMENDATIONS

1. The Long-Term Path

On the basis of the criticisms outlined above, CECA has developed an alternative approach to BEPS and set out a detailed scenario for the next twenty years. Our framework for policy-making balances five sets of considerations in a life-cycle cost approach -- technology, economics, social goals, practicability and national value calculations. CECA has developed an empirical example for cold climates to illustrate our approach and to determine the elements of an effective BEPS program.

Taking all factors into account, CECA finds that neither technology nor economics present real constraints to energy conservation and any problems of practicability are likely to be resolved over time. Therefore, periodic upgrading of the standards becomes essential. Under the CECA scenario, we project that by the year 2000, the average house can be built to use energy at the level at which super-efficient houses consume energy today.

We recommend, therefore, that BEPS initially be set 30 percent stricter than the level proposed by DOE. Further, we recommend that energy budgets be reduced by 15 percent every five years according to an explicit timetable. By the year 2000, the energy savings that would result from this scenario would be greater than 30 quads, which is the equivalent of more than 5 billion barrels of oil. In the year 2000, the savings would be the equivalent of 2.7 million barrels per day. CECA believes that this level of energy savings is a reasonable goal and that the scenario we have proposed for the BEPS program is entirely practicable and achievable.

2. The Short-Term Strategy

CECA believes that the overall program would be best served if Congress would grant DOE a short -- six month -- delay in issuing the final rule. In those six months, we believe that DOE could accomplish the basic modifications in research and approach that are necessary to begin the program.

During this time, the implementation rule should be completed. Simultaneously, the budget setting rule should be reworked. This should include:

First, the basic simplification of the program -- the elimination of weighting factors, the calculation of equivalences between BEPS and current prescriptive codes, the preparation of manuals of recommended practices, and

Second, a reassessment of the various decisions and faulty data bases which led energy budgets to be set too high.

In order to ensure that these goals are met, CFCA recommends that a number of necessary steps be taken:

*DOE should form a research advisory group representing all the constituencies which are vitally affected by the BEPS program -- builders, architects, labor, consumers, conservationists, local government officials and others which Congress or DOE deems necessary.

*Congress should require DOE to establish an explicit timetable for achieving specific research goals, a schedule to which DOE can be held accountable.

*The Congress should transfer ultimate authority for the program from the Department of Housing and Urban Development to the Department of Energy so that a coordinated program will be possible and so that an adequate commitment of personnel to the program can be made.

*This should be coupled with a firm commitment at the highest levels of the Department and the Administration to provide the program with the resources necessary to make it effective.

*Once the final rule is promulgated, DOE should adhere to the currently mandated procedure of allowing a one year period for full implementation. Further delay should not be allowed.

*That one year period prior to implementation should be used to gain significant large scale experience with the program. Voluntary compliance should be encouraged through educational programs. Funded demonstration projects should be undertaken. These projects would be most effective if they were undertaken at a variety of levels -- federal, state and local. At present, attention is focused almost entirely on the federal and state levels, but since it is the cities and other local units that will actually administer the program, it is of paramount importance to involve units at this level as soon as possible. By covering geographically and organizationally diverse scope of units, the greatest learning experience will be achieved.

CONCLUSION

In conclusion, I would like to stress the serious consequences of any undue delay in moving forward with the BEPS program. A six month delay, such as we have proposed, will push the effective date for full implementation from August 1981 to February 1982. Each day of delay allows as many as six thousand energy-inefficient housing units to be constructed. It allows as much as six million square feet of commercial floor space to be constructed each day. The result is a considerable waste of national energy resources.

In 1976, when Congress mandated BEPS, America's energy future looked bleak and Congress rightly judged that conservation in new buildings could contribute significantly to improving that future.

Today, when our energy future looks indeed a great deal bleaker, that intital response is even more appropriate. Now is not the moment to back down on the commitment that Congress has made to conservation. Congress should permit neither foot-dragging bureaucrats nor a recalcitrant industry to be allowed to jeopardize the nation's energy future by undermining a positive, productive and important conservation program such as BEPS. This is, indeed, the moment to be aggressive and decisive in our energy-conservation efforts.

TABLE 1

INCREMENTAL ADDITIONS TO NATIONAL ENERGY RESOURCES
(with various conservation and production strategies)
(in Quads)

	1990		2000		2010	
	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
PRODUCTION	4.6	41.4	40.6	115.6	65.5	138.5
Biomass	.8	4.3	1.9	5.4	1.9	5.4
Solar	1.7	6.4	3.8	22.6	8.8	18.8
Hydro	0	.1	0	0	0	0
Coal (Net)	1.0	6.3	4.1	37.3	4.1	33.5
Synfuel	.4	3.6	.1	5.4	2.6	10.6
Shale	.7	3.2	1.0	2.5	1.5	3.0
Geothermal	0	1.8	.7	6.9	1.7	17.5
Nuclear	0	3.0	15.0	17.5	25.9	26.7
Oil	0	5.0	6.0	8.0	10.0	12.0
Gas	0	7.7	8.0	10.0	9.0	11.0
CONSERVATION:*	19.6	31.2	22.5	54.4	46.9	73.0
Buildings	8.0	13.0	10.0	23.9	18.2	28.8
Appliance	1.2	1.9	1.7	2.7	2.7	3.6
HVAC	2.3	2.9	2.1	4.1	4.1	5.3
Retrofit	3.3	4.7	1.4	5.2	1.3	1.7
Envelopes	3.1	3.6	1.1	1.8	.9	1.2
Solar	.2	1.1	.3	3.4	.4	.5
New Buildings	1.2	3.4	4.8	11.9	10.1	18.2
Envelopes	.7	1.8	2.6	5.0	5.8	7.7
Solar	.5	1.6	2.2	6.9	4.3	10.5
Transportation	6.1	11.0	6.4	16.1	13.2	21.6
Automobile	4.4	7.9	4.5	11.6	9.5	15.6
Light Truck	1.0	1.9	1.2	2.7	2.2	3.7
Other Truck	.4	.7	.4	1.0	.8	1.3
Air Passage	.2	.3	.2	.5	.4	.6
Rail	.1	.2	.1	.3	.3	.4
Industry	5.5	7.2	6.1	14.4	15.5	22.6
Cogeneration			1.3	3.5	2	5
Housekeeping			4.8	9.1	6.2	6.2
Process				1.8	7.3	11.4

Source: Consumer Energy Council of America, Energy Conservation in New Buildings: A Critique and Alternative Approach to the Department of Energy's Building Energy Performance Standards (Washington, D.C., 1980) p. II-35.

Senator **Durkin**. Doctor, let me ask just a couple of quick questions.

Don't you think that the bankers are now beginning to take into consideration the cost of energy over the period of the mortgage?

I mean, that is a factor when the loan officer decides to grant the loan or not.

Isn't that already having an impact?

Dr. **Cooper**. It certainly is beginning to take place. And we encourage it. And in our report, we recommend it.

We believe that under the act which created BEPS, the Secretary of Energy has the power to encourage and foster that approach.

One of the problems, as was pointed out in testimony in the last session, if you plot the response of the housing market, it tends to be a slowly responding market.

You converge with BEPS some time after 1990. We don't believe that the Nation can afford that sort of slow response. That is one of the fundamental reasons we think regulation is necessary.

Senator **Durkin**. Yes. But you are assuming that DOE, which has yet to have its first success, is going to move forward efficiently with BEPS.

I question that fundamental assumption.

Dr. **Cooper**. Well, as I said, we have a series of recommendations, a specific timetable, proper resources, constant Congressional inquiry about the program.

I think, as I look over the bill you have proposed, there are a number of provisions we completely agree with.

And even in those we would disagree with I find things that I would emphasize; for instance, in directing the President to establish the voluntary program. We think the administration has not come out in sufficient support of the program.

It is a question of hunkering down, getting the resources and making sure the job gets done. It has to be done.

Senator **Durkin**. Well, my problem is, you know, we have seen and heard all the speeches on alternatives and then watched OMB come over to the Appropriations Committee and fight against every appropriation.

And presidential declarations don't burn too well in New England.

Let me ask you another basic question. Do you think, really, we can conserve energy in this country by Federal regulation, the Washington, programmatic, bureaucratic approach?

Dr. **Cooper**. I think a combination of proper incentives and regulation is necessary.

As I pointed out, a series of major national studies have examined the housing market. The Ford Foundation had the most complete commitment to a pure market approach, to energy conservation and the solution to the energy problem one can imagine.

And they made an exception to the building market. They said, "Here is one case where intelligent regulation can play a very important role."

I think it is a sound judgment, and I quite agree that we need to work very hard to make it work. We have to do so and we have to do so quickly.

Senator **Durkin**. Well, you mentioned incentives. Can't we use the tax code and, you know, maybe modify the capital gains on the resale of energy-efficient buildings and eliminate the Washington bureaucratic, programmatic approach?

Dr. **Cooper**. Well——

Senator **Durkin**. Edison would have said, "The hell with it." He would have given up on the light bulb and opened a hotdog stand in Hoboken if he had to do business with the Department of Energy.

I mean, I think it is a serious problem.

Dr. **Cooper**. The data I have seen on the response to the tax incentive program has not been all that reassuring either.

And that is why I suggest we need a combination of carrots and sticks. Clearly, as we have seen in the response of the building industry on a number of others, BEPS is a significant stick. If we combine it with the proper carrots, I think it can work.

Senator **Durkin**. Thank you.

Mr. Newman?

Mr. **Newman**. In addition to the reasons that I indicated in my testimony why one can afford or why one must wait for 2 years, instead of 6 months, I would like to cite two additional reasons.

The first is that housing, in particular, building, in general, is in a recession. And when you don't build buildings, you save the most energy.

Buildings are not being built. And let me tell you that that price, which goes beyond the saving of energy to the American economy, is one heck of a price. And I don't think that the American public or the American consumer wants to pay that price.

Senator **Durkin**. In my own State, and we are the second fastest growing State east of the Mississippi, constricting the housing market is just setting in motion another inflationary surge in the housing market.

Mr. **Newman**. First, statistics do not take into account the fact that the housing starts are down.

Second, let us not underestimate the wisdom and the ability and the smarts of the consumer. Tenants today, lenders today, users today, are demanding more energy efficiency, and the owners are giving it to them.

I will tell you one thing further, that owners are beginning to build today more effectively and efficiently because it is a means of protecting their investment.

Putting on my private sector hat, my company has $1½ billion worth of commercial construction underway. And I can tell you that every one of those buildings, in addition to buildings of some of the competitors that we deal with, meet that, more or less, meet BEPS.

Market forces are working. And if you were to make a current study of what today's buildings that are coming out of the ground are in terms of energy consumption and efficiency, you will find at least in the commercial market, where I can speak with great assurances, that we are here in terms of BEPS.

And I hope that this does not become the rationale for regulators to say, "Well, the market forces are working and the building community is responsive and responsibile. And, therefore, let's squeeze them a little more."

Now, in terms of housing, this recession is buying time. And I believe when the recession is over in housing, that the work behind the scenes, given this extra time, that the housing community will produce housing in 1981 that will be a far sight more efficient than that produced in 1980.

Dr. **Cooper**. With respect to what is happening now, I would invite the Senator and the members of the staff to take a tour of the Washington area, a 30- or 40-mile radius. I have been doing that systemmatically.

Senator **Durkin**. This year, I am restricting my tours to New Hampshire. [Laughter.]

Dr. **Cooper**. Let's look at housing starts recently. If you look at the 1979 survey of the National Association of Home Builders, which I have recently looked at, you will find that the buildings are—as I said, two-thirds are far off the optimum in energy efficiency.

This is the concept of replacing simple change for maximum practicable improvement—a very strong phrase which was carefully chosen by Congress.

Senator **Durkin**. Thank you, gentlemen.

There are many more questions and we could debate the better part of the week.

My fundamental concern is that I have more faith in the people at home and around the country than I do in DOE and the bureaucratic approach, but that is, I suppose, my bias.

Thank you, gentlemen.

Now, we will turn to panel 2: Mr. Vosbeck and Mr. Bush.

If you will identify yourselves for the record, your statements will be printed in their entirety.

STATEMENT OF JOHN S. BUSH, JR., CHAIRMAN, BUILDING TECHNOLOGY EXECUTIVES GROUP. U.S. CHAMBER OF COMMERCE; ACCOMPANIED BY BILL KELLEHER, ASSOCIATE DIRECTOR, CONSTRUCTION, HOUSING, AND COMMUNITY DEVELOPMENT

Mr. **Bush**. Mr. Chairman, I appreciate very much being here.

Now that we have heard the virtues of what I can only describe as an energy police state, I think that our comments might seem a little eccentric based on what the Washington Post said yesterday, that 87 percent of DOE's budget is for consultants.

I would like to inform you that we have never had a contract with DOE, nor has the U.S. chamber. So, as I say, we might sound a little eccentric here this morning.

I am vice-president of governmental affairs of the United States Gypsum Co. and chairman of the U.S. chamber's Building Technology Executive Group.

With me is Bill Kelleher, the chamber's associate director for Construction, Housing and Community Development.

The U.S. chamber supports both energy efficiency and the use of performance standards.

The chamber opposes the issuance of BEPS in its current form because it creates cost, uncertainty and bureaucratic delays well in excess of any real benefits proposed in the proposed rule.

However, we believe the efforts to develop a BEPS program should continue and DOE should redesign its proposal in close consultation with all elements of the building community.

BEPS must be redesigned but, rather than relying on computer simulations, they must get into the real world experience for more cost effective energy efficiency measures to be used in construction.

We go on, then, Senator, to point out seven very specific problems that are contained in the present BEPS proposal.

No bureaucracy is vast enough or efficient enough to police each and every new building project in this country or the coded adoption process in each municipality to insure compliance with BEPS by the use of either sanctions or subsidy.

To be implemented effectively, BEPS must be a voluntary program because it has won support based on its merit and value in the local community, among builders, among bankers, design professionals, consumers of housing and other buildings and all other elements that must construct and use our built environment.

There is a general agreement that the current proposed rule is inadequate. Serious questions have been raised about all aspects of DOE's proposal, and major deficiencies have been highlighted by groups ranging from the National Institute of Building Sciences, who testified here this morning, to the Regulatory Analysis Review Group and the President's Council on Wage and Price Stability.

The homebuyer, the business community and the general public should not be asked to bear the risks and pay the costs that will come from implementing this ill-conceived Federal regulation.

A formulation process for BEPS should begin again, in very close consultation with all elements of the construction community.

No decision to impose this standard on either public or private construction should be made until after comprehensive tests have shown that the use of BEPS will safely and economically reduce the amount of energy used in new buildings.

In summary, no one can question the need for building more energy efficient homes and offices.

The consumer interests of homebuyers, homeowners, investors, is in reducing operating costs. And, today, energy costs are one of the most rapidly escalating costs in the entire economy.

The private sector has responded and continues to respond to this interest.

Experts estimate that energy consumption in commercial buildings has been reduced by as much as 30 percent in recent years. And most of the data you have heard here this morning is based on buildings built in 1974 or 1975 which were designed back in 1969 and 1970, before the very serious nature of our cost of energy were comprehended.

Changes are being made.

I have had the pleasure, Senator Durkin, of speaking with about 11 homebuilder groups and associations on a State basis, from coast to coast and in between, over the last 4 months.

And in speaking with their executive vice presidents of these groups and asking them, "What can we do?", and the homebuilders in Washington, "What can we do to assist you?", there are two things that their builders are interested in.

One is how to get affordable mortgage money for people to buy their houses. And two is, what ideas can you give us for improving energy efficiency because everybody who comes to buy a home, that's what he is asking us for and that is what he is demanding? And this is what they need to sell homes.

Because of the current increases in the price of energy and uncertainty about future increases, the natural forces of the marketplace are bringing more and more progress in energy efficiency as it relates to the construction community.

We believe BEPS should assist the marketplace in bringing about these changes, and we believe that a more carefully constituted BEPS on a solely voluntary basis can make that contribution to our society.

Senator **Durkin**. What do you think it will cost on a voluntary basis? I mean, what is the governmental cost?

Mr. **Bush**. I don't understand your question, sir.

Senator **Durkin**. If it is purely voluntary, what do you think it will cost to have someone manage—implement the voluntary program?

Mr. **Bush**. It seems to me that the nature of a free economy is that it will cost the least possible to get the job done because, if homebuilder A does not achieve that energy efficiency with his homes at an equal or lesser cost than homebuilder B, it is the latter who is going to sell the homes and the former who is not.

But since these sort of costs in the sort of rigorous regulatory environment that we heard about from the previous speaker—since the final costs are not tantamount elements of consideration, then it has to cost more under a regulatory system.

Senator **Durkin**. Well, maybe my question was not as clear as I thought.

If it is only going to be a voluntary program, why incur the cost of a voluntary program? Is there a need for a voluntary program?

Mr. **Bush**. Well, what we mean by a voluntary program is, as I say, the homebuilders and other construction factors in the country are very hungry for ideas of how can they save more energy.

So that if we have a bona fide source of information, which is collecting it and disseminating it, which is a reasonable governmental function, I believe, they will grab this up, but they will do it on a voluntary basis and not on the basis of somebody shoving it down their throats.

Senator **Durkin**. Well, following that one step further, if it is going to be a voluntary program, it's going to be a question of education and disseminating information, why can't the chamber, why can't the homebuilders, why can't half the trade associations here in Washington disseminate that information now and eliminate the need for whatever burden it is going to be to have bureaucrats at DOE or HUD involved at all.

Mr. **Bush**. Well, we are doing that but, politically, you know, I think the reality is that there are a number of people who have not been exposed to the realities of the world and they still think big government is the answer.

So, we are going to have a Government program, I think. I believe we will get the job done anyhow, yes.

Senator DURKIN. I mean, there are studies that have little studies, you know, gathering dust all over the shelves in most of the Federal buildings.

Mr. BUSH. I am in a group called the National Council of the Housing Industry which is the supplier group of the National Association of Home Builders.

We have sponsored a program called the energy-saver house that has been going on now for about 18 months.

First, we invited all of the 43,000 homebuilder members to submit their best ideas on how they could construct the most energy efficient house.

We selected—we had 260 apply to us with their ideas, and we have selected 10 which are geographically dispersed in the country.

And they now are building those homes. And, then, we are going to totally and thoroughly disseminate the results of what they have done and what the ideas are that they have come up with and that kind of education program is going on.

Senator DURKIN. I mean, God knows, the high interest rates and restrictive credit and so forth has hit the housing industry unnecessarily hard.

But isn't there also an underlying problem in the housing industry that we have to find a way to construct housing more efficiently and with new products.

I just read about someone out on the west coast who was using styrofoam with concrete block, putting houses up for one-third of what they would be in the normal market.

And a BEPS program or program such as this just at the time the housing industry needs to reinvigorate itself, use new methods, aren't we going to run the risk of the bureaucrats freezing the technology or freezing the approach at absolutely the wrong time?

Mr. BUSH. Well, you are. But there is this total frustration on the part of the homebuilder who builds five or six units a year.

You understand that that is how most of the American homes get built.

And these folks come in with this computer program where their national association has purchased the best computer talent obtainable.

They have run the program and found no way really to make it work, and where they have produced results, the variations have been as much as 50 percent margin of error.

Now, how is the small businessman, who is the typical home builder in the United States, going to be able to live under that situation? You are going to frustrate him out of business.

He would be better off getting Edison's hotdog stand.

[The prepared statement of Mr. Bush follows:]

STATEMENT
on
BUILDING ENERGY PERFORMANCE STANDARDS
before the
SUBCOMMITTEE ON ENERGY REGULATION
of the
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
for the
CHAMBER OF COMMERCE OF THE UNITED STATES
by
John S. Bush, Jr.
June 26, 1980

I am John S. Bush, Jr., Vice President, Governmental Affairs for the United States Gypsum Company. My appearance today is on behalf of the Chamber of Commerce of the United States where I serve as chairman of the Chamber's Building Technology Executives Group and as a member of the Construction Action Council Executive Committee. I would also like to introduce William D. Kelleher, the Chamber's Associate Director for Construction, Housing and Community Development. The U.S. Chamber welcomes this opportunity to express its views on the implementation of the Department of Energy's Building Energy Performance Standards (BEPS) program. Energy efficient structures are of keen concern to the Chamber's over 97,000 membership consisting of business firms, trade associations and state and local chambers of commerce.

The U.S. Chamber supports both energy conservation and the use of performance standards. More energy efficient buildings can make a major contribution to the nation's effort to conserve energy and offers an opportunity to encourage innovation and emphasize results without bogging the construction community down in red tape. The Chamber opposes the issuance of BEPS in its current form because it creates costs, uncertainties and bureaucratic delays well in excess of any real benefits the proposed rule can provide.

However, the efforts to develop a BEPS program should continue and DOE should redesign its proposal with input from all elements of the building community and the National Institute of Building Sciences as required by the Energy Conservation and Production Act of 1976 (P.L. 95-385). If necessary, DOE should seek additional time from Congress to accomplish this task if such time is required.

A redesigned BEPS should reflect the complexity and interdependence of the construction process. It should be based on real work experience and cost-effective conservation measures rather than relying on computer simulations as the current proposal does. DOE should use the expertise and coordinating talents of the consensus standards process to hone BEPS for accuracy and ensure its completeness.

The Chamber recommends that the BEPS implementation process be based on voluntary adoption by states and localities. An education program for builders, design professionals, code officials and building material manufacturers must be included as part of the implementation program if a BEPS program is to have any real impact on the construction industry.

SPECIFIC PROBLEMS

In reviewing the proposed rule, the U.S. Chamber has identified the following problems:

Cost: By DOE's own estimate residential construction costs will increase by 75 cents to $1 per square foot and add $1,755 to the cost of building the average home. However, the regulatory costs of BEPS will match and may exceed the increased construction costs for materials and labor. For example, several experts in the home building industry have stated that the cost to the builder of preparing an initial evaluation of an individual home under BEPS will be $2,000 per home. This is $250 more than the improvements made for energy conservation. In addition to the costs of these initial proposals, the cost associated with review by code officials and the negotiation of any differences of opinion between the code official and the builder in determining the final design will also have to be added to obtain the true costs of BEPS.

Commercial construction costs will also increase under BEPS. Estimated increased costs in this type of construction range from three to five percent resulting in an approximately one billion dollar increase in commercial construction costs per year.

Will these increase costs save energy? Not necessarily. The standards proposed by DOE effect design standards. They do not control actual energy use or costs. Because of the newness of many of the methods in the field of energy conservation, it is difficult to predict what the actual results of design changes will be. However, it should be noted that even if the proposed standards worked exactly according to DOE's estimates, only one percent of our current annual energy needs would be saved. In DOE's own cost-benefit analysis, the Department recognizes that the level benefits and savings projected for BEPS is so small that they may actually reflect the statistical error allowed under their calculations. The true cost benefit-ratio for the program could be negative.

The Chamber agrees with the General Accounting Office (GAO) recommendation contained in its report Uncertainties About the Effectiveness of Federal Programs to Make New Buildings More Energy Efficient in which GAO calls for the use of energy consumption data based on actual and verifiable experience for the formulation of BEPS rather than the limited use of computer simulation data.

Missing Parts: DOE has failed to provide the public and the construction community with all the information it needs to evaluate completely the proposed rule. The Department continues to put out partial proposals or documents, but as each is found deficient, the Department promises that the next issuance will be complete and represent the "real" position. This has made the commenting process difficult and expensive for those who will be forced to live with this rule. DOE's issuing of a several hundred page long technical supplement to its Draft Environmental Impact Statement less than three weeks before comments on the proposed rule are due is a clear example of this problem.

Lack of Knowledge: Building and designing energy efficient structures is an emerging art. While many old techniques are being rediscovered and existing knowledge applied more efficiently, there remains many areas of uncertainty and substantial opportunities for new discoveries.

In DOE's own analysis of BEPS, the Department admits that it does not know how BEPS will impact health and safety codes for buildings. DOE should not put forward a rule until it can offer some clear answers in this area.

Slowing of Innovation: Energy saving materials and methods will be emerging rapidly in the coming years. BEPS will slow the application of new technogy into the building process by adding a bureaucratic hurdle to its introduction. Under BEPS, energy savings will be measured in terms of design criteria and evaluation technique rather than actual reduced energy consumption. Until a new technology is accepted into the BEPS process, designers and builders may be unable to use it because it will have a negative effect on the design energy consumption score they receive under BEPS.

Data Base: The data base behind BEPS is too limited. Only one commercial building had been subject to a life cycle cost analysis and DOE's residential sample was also limited. This one building was part of a limited group of only 168 buildings that was subjected to an abbreviated computer analysis. The limited nature of this sample comes into clearer focus when it is recognized that the sample must be divided by over a dozen building types and approximately 10 locations. Perhaps the most important deficiency in DOE's background work was its failure to go beyond mere computer simulations and develop practical experience on this issue.

BEPS residential simulations were also run for only 10 locations and then extrapolated for the 78 areas listed in the rule. Within the 78 locations for both commercial and residential use, no consideration was made for micro-climates or the impact the owner, manager or residents' operational conservation methods -- such as setting back thermostats at night -- could have on the standard.

Many of the data base problems related to this program reflect the fact that any computer simulation, no matter how complex is based on a model of reality which must by its nature simplify and assume rather than perfectly mirror real situations. The consequence for BEPS is that certain major energy saving considerations have been left out of its current Standard Evaluation Technique (SET) proposal, such as daylighting credit for fenestration products, i.e. windows, sliding-glass doors and skylights. Also as various groups in the homebuilding industry have made comparisons between the projected energy use based on DOE-2A, the current SET for residential purposes and actual metered homes, the DOE-2A projected results have been found to be in error by as much as 50%.

As more and more associations, builders, designers and materials manufacturers work with the data base and technical tools related to BEPS, the Chamber believes more flaws, omissions and special circumstances will be discovered. It is one of the paradoxes of this rule that as the evaluation technique and associated design energy budget levels and design energy consumption levels are made increasingly complicated to more closely parallel reality, they become less practical for use by the average homebuilder or other member of the construction community.

Weighting Factors: DOE has used national averages for weighting factors when significant regional variations exist. From the amount of well reasoned debate on all sides of the weighting factor issue, it is clearly premature for DOE in a BEPS rule issued in August to cut off discussion on this issue.

Liability: A BEPS rule will create numerous liability questions for all those who design, supply construction materials for, build and finance residential and commercial construction. It is unclear, at present, what responsibilities and accountabilities are created both under the Federal regulation and the various state and local building codes that DOE is proposing be amended to include the BEPS rule or its equivalent.

Implementation: The implementation of BEPS will be based on the credibility and legitimacy of the standards. Unless the standards developed by DOE are accepted by all elements of the construction community and consumers of new construction as fair, accurate and obtainable, no implementation program can succeed. The size, diversity and complexity of the construction industry, state and local government and the code community requires the willing cooperation of the vast majority of the members of all these groups if BEPS is going to have any meaningful impact on energy conservation. No bureaucracy is vast enough or efficient enough to police each and every new building project in this country or the code adoption process in each municipality to ensure compliance with BEPS by the use of either sanctions or subsidies.

To be implemented effectively, BEPS must be a voluntary program that wins support based on its merit and value to local communities, builders, bankers, design professionals, consumers and all other elements that must construct and use our built environment.

There is general agreement that the current proposed rule is inadequate. Serious questions have been raised about all aspects of DOE's proposal and major deficiencies have been highlighted by groups ranging from the National Institute of Building Sciences to the Regulatory Analysis Review Group (RARG) whose comments were submitted to DOE by the President's Council on Wage and Price Stability (COWPS).

The business community and the general public should not be asked to bear the risks and pay the costs that will come from implementing this ill-conceived Federal regulation.

The formulation process for BEPS should begin again with input from all aspects of the construction community. The voluntary consensus standard writing process should be used to the maximum degree possible. After the standard is developed it should be subjected to substantial field testing in various parts of the country and for a broad range of building types.

No decision to impose this standard on either public or private construction should be made until after tests have shown that the use of BEPS will safely and economically reduce the amount of energy used in new buildings.

To ask states and localities to adopt an untried and unproved standard is asking them to be reckless and imprudent. To ask builders, bankers, home buyers and real estate investors of the country to pay for program costs that have no proven benefits is asking them to waste their precious resources on potentially energy inefficient homes and offices.

Also, BEPS could be only part of a program of energy conservation within a state or locality. New buildings constitute only a small portion of the built environment. For many communities the most important conservation programs will focus on retrofiting existing buildings and changing local transportation patterns. These communities should not be forced to delay their local programs and put aside their local priorities because of a bureaucratic decision in Washington. The resources of state and local governments are extremely limited in terms of both money and manpower. To impose a mandatory program on these units of government without respect to local needs or decisions would be both inefficient and ineffective in terms of saving energy.

It is also important to remember that those states and localities who elect to go forward now with a performance oriented approach are free to do so. Forty-four states have already adopted energy conservation codes. In addition, DOE has pledged to continue to work with state and local government in improving their standards. The coordination of a national BEPS program with state and local standards will also have to face issues such as:

- Equivalency and Substantial Compliance: A process must be developed for determining what codes are equivalent to BEPS or what revisions to existing codes are needed to make them equivalent. Also, how precise must equivalence be? What tolerance will there be for different approaches or different standards?

- Educational and Technical Assistance: Education and training will have to be provided to the design professions, code officials, builders and other members of the construction community. This program will require both time and money for training those currently in the field and the development of additional academic resources for training members of the various groups affected by BEPS.
- Code Administration: Local enforcement mechanisms must be established and procedures for maintaining and updating the BEPS element in a code must be established along with a program of training and professional development for those who use the codes.

DOE's implementation plan should recognize that the vast majority of codes, code officials and construction professionals in both the design and building phases of the process are not prepared to switch from a prescriptive to performance standard because of Federal regulatory *fiat*. It will take a long term training and education program for those who will actually have to live with a BEPS-style code before they will be capable of administering this standard.

SUMMARY OF RECOMMENDATIONS

No one can question the need for building more energy efficient homes and offices. The consuming interest of homeowners and investors is in reducing operating costs and today energy costs are one of the most rapidly escalating costs in the entire economy.

The private sector has responded, and continues to respond, to this interest. Experts estimate that energy consumption in commercial buildings has been reduced by as much as 30 percent in recent years. Numerous homebuilders around the country are making major improvements in the energy efficiency of the homes they offer to consumers because buyers demand them. The National Association of Home Builders and other national, state and local industry groups have been working with all elements of the construction community to improve the energy efficiency of their products.

Because of the current increases in the price of energy and uncertainty about future increases, the natural forces of the marketplace are bringing more and more progress in energy efficiency as it relates to the construction community. We believe BEPS should assist the marketplace in bringing about these changes.

The Chamber's position is that BEPS should be a voluntary program. The states and localities should be free to select those aspects of BEPS they feel are appropriate for their communities. BEPS should continue to be developed, but it should not displace other standards such as ASHRAE-90 or the HUD minimum property standards. BEPS should be subject to vigorous testing before it is put into effect. BEPS should be viewed as an education and research effort that will greatly assist in the adoption of performance-oriented conservation measures by states and localities at a pace appropriate to local initiatives. The implementation of BEPS should come through the existing building code structure in cooperation with the private sector and various voluntary standards organizations. No new bureaucracy should be created.

In its final form, BEPS should be developed in such a fashion that it would be possible to develop equivalent prescriptive codes. Unless there is a prescriptive equivalent capable of use and understanding by the construction community, any BEPS program will be irrelevant to the vast majority of builders in this country.

In addition, BEPS should not be imposed on other Federal construction mortgage insurance or loan programs until it has been proved cost-effective in actual field tests.

The Energy Conservation and Production Act of 1976 (Public Law 94-385), which authorizes the development of BEPS, calls on DOE to formulate the program with input from all elements of the construction community and the National Institute of Building Sciences. The National Chamber recommends DOE take the time to fulfill this mandate of the law which we believe is more important to the development of a valid BEPS standard than meeting an artificial deadline for the development of the rule.

Senator **Durkin**. Thank you.

Mr. Vosbeck?

STATEMENT OF R. RANDALL VOSBECK, PRESIDENT ELECT, AMERICAN INSTITUTE OF ARCHITECTS; ACCOMPANIED BY DAVID MEEKER, EXECUTIVE VICE PRESIDENT, AIA; AND DAVIS TOMASIN, DIRECTOR OF CONGRESSIONAL LIAISON, AIA

Mr. **Vosbeck**. My name is R. Randall Vosbeck. I am a practicing architect in Alexandria, Va., and president elect of the American Institute of Architects.

With me today is David Meeker, the executive vice president of the AIA, and Davis Tomasin, the institute's director of congressional liaison.

We are certainly pleased to be here today to comment on the building energy performance standards and to offer our recommendations for their rapid and effective implementation.

The American Institute of Architects has been involved in promoting energy-efficient buildings for many, many years; decades.

Buildings account for nearly 40 percent of our total national energy consumption and, therefore, offer a great opportunity for energy conservation.

The AIA worked closely with Congress on the Energy Conservation and Production Act in 1976 which directed the development of BEPS.

When Congress passed this landmark energy legislation, the AIA ran a full page ad in the Washington Post commending the courage and vision of Congress in passing so crucial a program in response to our energy dilemma.

As we then proclaimed, mandating energy performance standards for new buildings was a giant step forward for energy conservation.

One month ago, it became apparent that efforts to unnecessarily delay or even eliminate the promulgation of BEPS by 2 years beyond the legislative mandate were gaining ground, the AIA acted on behalf of the energy consumers of our Nation to emphasize the urgency of the situation and to engage public discussion.

We returned to our unusual action of 4 years ago prior and ran another full-page ad in the Washington Post.

Unfortunately, this time, the institute could not publicly commend but, rather, had to question whether Congress was about to take a giant step backward on energy conservation.

Saturday's Senate floor action and passing, unamended, section 316 of the Housing and Community Development Act, allowing the promulgation of BEPS to be delayed 2 years is just such a step backward.

The American consumer will be again forced to bear the burden for this country's continuing failure to implement adequate energy efficiency and conservation programs.

We can only urge that the Senate conferees will more thoroughly examine the absolute necessity of the BEPS program and evaluate the negative impact of this arbitrary 2-year delay in terms of our energy future.

The AIA remains committed to Congress criginal legislative intent which called for the rapid promulgation and implementation of BEPS.

The potential energy savings with the utilization of building performance standards are far greater than any alternative prescriptive energy standards.

DOE's latest figures indicate that BEPS will save over 358,000 barrels of oil a day by 1995 and 436,000 by the year 2000.

In addition, BEPS allows designers and builders the flexibility to choose any number of conservation techniques to meet the energy budget requirements and, thus, encourages creativity and innovation.

The esthetic quality of our built environment where we live and work will undoubtedly improve.

When the notice of proposed rulemaking was issued by the Department of Energy last November, the AIA energy committee formed a special group to study BEPS.

The recommendations of the task force whose members are architects specializing in energy conscious design, were presented to the Department of Energy during the public comment period on BEPS.

I have submitted both our general statement and the technical backup material to this committee, and will summarize 2 important elements of AIA's response.

On implementation, the institute has studied the BEPS implementation issue very carefully and recommends that a 2-year phased implementation process begin immediately.

This plan calls for a dual path approach, using both building performance and component or prescriptive standards for a limited time.

Specifically, our recommendations include that BEPS be promulgated as currently scheduled, that DOE implement a BEPS immediately, even before final promulgation in all 18 Federal building types, throughout all geographic and climate zones.

An executive order could initiate this important action. We think it is important for the Federal Government to take the lead here.

Designers would be required to submit an annual energy use analysis of the building with each building permit.

For no more than 2 years, local building code officials could issue building permits upon receipt of this energy analysis even if it did not meet the energy requirements of BEPS provided, however, that the design met all existing energy code requirements.

Then, at the end of this 2 years, the component or prescriptive standard could no longer be used, and all designs would then be required to conform to minimum BEPS criteria.

This implementation plan—and let me repeat, with Federal buildings providing an immediate BEPS demonstration program—will also provide DOE the necessary time to refine the existing standards and give the building industry experience in working with the standards before being subject to sanction.

Another important point: Education. An obvious key to the success of BEPS will be the priority given to educating design professionals, the architects, the engineers, the builders, code officials, the public.

We recommend that DOE immediately undertake comprehensive BEPS educational program; that DOE follow the recommendations of the General Accounting Office study to expedite its implementation plan, working more closely with States and local jurisdictions on the compliance procedures; and that the BEPS educational process work in cooperation with all elements of the building industry.

Now, DOE, alone, cannot assume the total responsibility for an education program. As I mentioned, all elements of the building industry must share in this responsibility and this effort.

In response to the need for educating our profession, the architects, the membership which is comprised almost entirely of small firms—10 or fewer total employees—our AIA board of directors has made energy education our top priority for the institute.

And we have put our money up to accomplish this program.

We believe that our members will quickly respond to the design challenges that BEPS provides.

Quickly, some further recommendations——

Senator DURKIN. Could I ask you a question?

Mr. VOSBECK. Yes, sir.

Senator DURKIN. Architects are intelligent, creative people. Why do you have to wait for a Federal Government program to unleash your creativity?

Mr. VOSBECK. Senator, we are not waiting. We are accomplishing a lot.

Right now, there are prescriptive codes here and there, and we think that we can be much more creative with a performance code.

We don't think we can wait. We think there must be some regulations to push this thing forward in an intelligent way which we think is the performance way, as opposed to the prescriptive.

Mr. MEEKER. Senator, I think it is important to recognize, too, that there are multiple participants in the design of a building, among which is the owner and some of the users.

The architect can only push so far. But if the owner and the users do not perceive that energy conservation is in a national and their own interest, you cannot push a wet noodle under a door.

Senator DURKIN. No, but he can't tell the oil man he will pay him next week, either.

I mean, if a person can add, he has got to take account of energy costs. I have been up that street. I had two apartment units that were electrically heated during the first embargo and no tenants.

I mean, it makes a very immediate impact when you get your electric bill or your oil bill.

Mr. **Meeker**. There is a move, but I think you have to recognize, in our tax laws, the cost of operating a building can be passed through.

It is a cost of business. Now, what kind of incentive is it to say that you can take some portion of this off of your business?

You can pass through as a renter, as the owner of a rental property, the cost of taxes and the cost of operations. And energy is predominant.

What is the major incentive there except if the consumers get absolutely fed up.

Now, Senator Jackson received a report the other day from the Congressional Budget Office which states, in their estimate, by 1985, we will be paying $142 billion more for energy for oil than we are now.

And the proposals that we are hearing suggest that we should wait until we are paying at that level before we begin to deal with the situation.

Our view is that we should attempt to deal with increments now, and the Federal Government is the largest single energy user in the United States.

Two percent of all the energy in the United States is used by the Federal Government. Forty-five percent of it is used in Federal buildings.

We feel it is appropriate before the Federal Government regulates everybody else that it see if it can regulate its own appetite.

Senator **Durkin**. I don't think anyone would argue with that, that the Federal Government be encouraged to set the lead.

But if the problem is as you say with the tax code, why are we going to set up another agency to try to force people to take action when the more immediate and more direct and more efficient approach would be to try to change the tax code and give tax incentives to energy conservation?

And, then, it is the businessman, the homeowner and his accountant, and we don't have to do business with the man from the Federal Government.

Mr. **Meeker**. I suspect that, in some areas, Senator Durkin, the efforts of the Congress in passing such legislation has not been sterling by example.

It would probably be equal to DOE in effectiveness in certain areas.

Senator **Durkin**. But you think we can recoup with BEPS?

Mr. **Meeker**. I think that we should do both. I think that you should create incentives. At the same time, I think you have to create opportunities and recognize that the States are involved in this and the localities are involved in this.

If you are going to get a consistent program working on a regional basis, you have to approach it from some broad premise.

Mr. **Vosbeck**. You know, we are running out of time. Hopefully, eventually, when we get regulation started and we get everything going down a path toward energy efficiency that the regulations can phase out.

But we are running out of time now.

Senator **Durkin**. Well, we have still got the Federal Tea-Tasting Board. Regulations never disappear.

Mr. Meeker. That's in congressional purview, sir. You could cut that off at any time.

Senator Durkin. That is all well and good, but there is a rule of 51 here. If you don't have 51 votes for it, forget it. Nothing moves without a majority.

Mr. Vosbeck. We have had a lot of discussion this morning, too, about DOE.

And I would like to just briefly hit that related to staff and funding.

Congress authorized 43 staff positions for BEPS, and the OMB subsequently cut the number of positions to 23 and internal DOE shifts reduced this number to 3 people.

Now, in comparison, the Department of Energy and Department of Transportation employ over 200 people to work on automobile efficiency standards.

It is difficult to understand the rationale of assigning only 3 people to a building program dealing with an industry that is significantly more complex than the automobile industry in a program which will yield far greater energy savings.

Senator Durkin. Well, look what happened on the auto standards. We were 6 to 8 weeks in conference on minimum mileage standards.

What we finally came out with was, if it rains Fourth of July, it will save more energy than the sum total of what the last energy bill produced.

The docks in this country are piled high with imports. Twenty-five percent of the cars sold in the United States today are imported cars.

And that is my problem. So, you have got 200 people at DOT working on it and only three at DOE working on the building.

I just have some real serious problems that the Government bureaucratic approach is going to solve our energy problems.

Mr. Vosbeck. Related to the automobile, you know, we put stickers on automobiles that give us miles per gallon on a certain regulation, and it would just seem so appropriate to have a similar rating system on a house so that a consumer can determine what kind of energy efficiency he is getting when he buys or rents a house.

Mr. Meeker. It also seems unusual that, in March, when our automobile industry declined 24 percent, that foreign vehicles had the third highest sales month in their history.

I suggest to you, while we have had a lot of industries who were saying, "Oh, we can't possibly do it," that the Japanese, the Germans and others have, in fact, exceeded the 1985 standard already.

Why is it that Chrysler, 2 weeks ago, says, "If we can't meet those standards by 1985, too bad for us"? Because the consumer is making a choice. There are 300,000 people standing on the street in the automobile industry right now because management in the automobile industry a few years ago, when that standard was set, said, "Oh, no, we can't possibly do that."

And it is this kind of decision that cost a lot of other people the money, the time, the hardship. And we feel if you delay on energy, you are going to find this to be an extended process.

Senator **Durkin**. Well, aren't you defeating your own argument though? I mean, we have stickers in the window of the 25-percent imports.

Isn't the thrust of your argument that standards and Government bureaucratic regulation did not solve the Chrysler problem or the Ford problem or the General Motors or American——

Mr. **Meeker**. It did not solve it. But it was interesting that, even with the import tax on bringing trucks and vehicles into this country, they are still more attractive to our people because they did respond to what we said was an energy standard for mileage well in advance of the 1985 date.

We now hear from General Motors, for instance, that they will not be able to achieve energy-efficient cars to meet the 1985 standard until 1983. But, yet, that standard has been in existence now for 5 years or more, and it has been talked about for 10 years.

Senator **Durkin**. Well, they are going to have to do something or they are going to go the way of the Pierce Arrow.

Mr. **Meeker**. And what about all of their employees?

Senator **Durkin**. Well, that's the problem.

Mr. **Bush**. Senator, I submit that it was Government regulation that got us here in the first place when we were paying 15 to 20 cents on the dollar compared to what they were in Europe for energy. That is what got our auto industry in the mess it is in. We didn't have to build them that way.

I mean, it was as cheap as water. We could spill it in the United States and it didn't make any difference.

And it is the same thing with the housing—or, with the built community. We have not had the demands placed on us for energy efficiency.

Now, we are coming up with results.

This continued reference to we've got to get it done and we've got to get it done quick, I suggest that it was that attitude of crisis in which this unwise regulation and legislation was established in the first place.

And it was not possible to get a good job done on this regulation in 3 years they've been working on it. I join you in doubting that, in 6 months, it is going to be made correct.

And I join you in your opinion that we must have successful demonstrations of this thing across the United States, not just in Federal buildings, because they have cute ways in the ways they do their accounting.

And I really do not know how much energy is being saved there. Plus, they have a captive group that they are working with, not my children or yours who leave a door open as often as they do and so forth.

So, I think we have got to have real world evidence that this thing works before it is made mandatory in any program.

Senator **Durkin**. Because even the analogy with the auto industry, we passed the clean air standard and anybody who has ever been in Washington in the summer knew it was necessary.

But, then, General Motors invested $100 million in the catalytic converter, and they wanted to get their investment back.

There may have been other ways. If it had been a voluntary approach or a modified approach, they might have come up with something other than the catalytic converter.

But we could debate that until the cows come home.

One question I would like to ask the panel: What is your projected energy saving with BEPS? We have gotten all sorts of figures on that.

Mr. **Vosbeck**. Well, we are using DOE's latest figures which indicate 358,000 barrels of oil a day by 1995.

Mr. **Meeker**. Senator, I think that there is an important role that you could play right on this very issue. That is, ask the General Accounting Office to take a look at this thing because figures are coming in from every corner saying from zero to impossible percentages.

And it seems to me that Congress could be best served by requiring its own investigative agency to provide it with some background before decisions were made.

Senator **Durkin**. Well, I saw your full-page ad and, if my memory serves me correctly, you estimated 12½ million barrels a day savings.

I was wondering where you got that figure and how that was arrived at. It seems to me we only use a total of 13 million barrels a day in the buildings sector now.

Mr. **Meeker**. That was by 1990, sir. It was based upon projections of increased use of fuel, and it was also based upon that BEPS was a cornerstone of the total conservation effort involving the built environment.

And that figure included, in part, in the ultimate, that we would have to soon begin to deal adequately with the existing housing stock, 80 percent of which will be standing here by the turn of the century, and that we will have to deal with the issue of neighborhood and community energy conservation, such as Portland, Oreg., San Jose, Calif., and others have been attempting to do.

It is predicated on a total building energy conservation effort.

Mr. **Tomasin**. Senator, there is no one in this room I don't think that knows what the impact of the energy crisis is upon citizens better than you do and the people of New Hampshire, certainly, who suffer.

We were very, very heartened when, this past week, the Democratic Party voted unanimously, the whole platform committee, to make the recommendation to the Democrats when they convene in New York that BEPS be implemented immediately and that it proceed with the Federal Government experiment first.

We thought that was a great step forward, and we wish to commend the Democrats for that effort.

Senator **Durkin**. Well, I had hoped that they would implement some of the stuff from the 1976 platform. [Laughter.]

Mr. **Tomasin**. Well, we were fortunate.

Senator **Durkin**. Have you concluded your statement, sir?

Mr. **Vosbeck**. Yes, Senator, thank you.

[The prepared statements of Mr. Vosbeck and Mr. Epstein follow:]

THE AMERICAN INSTITUTE OF ARCHITECTS

IMPLEMENTATION OF BUILDING ENERGY PERFORMANCE STANDARDS

A STATEMENT BY

R. RANDALL VOSBECK, FAIA

PRESIDENT ELECT

THE AMERICAN INSTITUTE OF ARCHITECTS

BEFORE

SUBCOMMITTEE ON ENERGY REGULATION

COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

JUNE 27, 1980

1735 NEW YORK AVENUE, N.W. • WASHINGTON, D. C. 20006 • (202) 785-7300

Mr. Chairman, my name is R. Randall Vosbeck, FAIA. I am a practicing architect in Alexandria, Virginia and am President Elect of The American Institute of Architects. Accompanying me today are David Olan Meeker, Jr., FAIA, Executive Vice President of the AIA and Davis J. Tomasin, the Institute's Director of Congressional Liaison. We are pleased to be here today to comment on Building Energy Performance Standards (BEPS) and to offer the AIA's recommendations for their rapid and effective implementation.

The American Institute of Architects has been involved in promoting energy efficient buildings for many years. Buildings account for nearly 40% of our total national energy consumption and therefore offer a great opportunity for energy conservation. The AIA worked closely with Congress on Title III of the Energy Conservation and Production Act of 1976 which directed the development of BEPS. When Congress passed this landmark energy legislation the Institute ran a full-page advertisement in the Washington Post commending the courage, vision and commitment of Congress in passing so crucial a program in response to our energy dilemma. As we then proclaimed, mandating Energy Performance Standards for New Buildings was a "Giant Step Forward on Energy Conservation."

One month ago, when it became apparent that efforts to unneccesarily delay the promulgation of BEPS by two years beyond the legislative mandate were gaining ground, the AIA acted on behalf of the energy consumers of our nation. To emphasize the urgency of the situation and to engage public discussion, we returned to our unusual action of four years prior and ran another full-page ad in the Washington Post. Unfortunately, this time the Institute could not publicly commend, but rather had to question, whether the Congress was "About To Take A Giant Step Backward on Energy Conservation?"

Saturday's Senate floor action in passing, unamended, Section 316 of the Housing and Community Development Act, allowing the promulgation of BEPS to be delayed by two years is just such a step backward. The American consumer will be again forced to bear the burden for this country's continuing failure to implement adequate energy efficiency and conservation programs. We can only urge that the Senate conferees more thoroughly examine the absolute necessity of the BEPS program and evaluate the negative impact of this arbitrary two-year delay in terms of our energy future.

The AIA remains committed to Congress' original legislative intent which called for the rapid promulgation and implementation of BEPS. The potential energy savings with the utilization of building performance standards are far greater than with any alternative prescriptive energy standards. The Department of Energy's latest figures indicate that BEPS will save 358,740 barrels of oil a day by 1995 and 436,333 barrels of oil a day by the year 2000. We believe that this is an extremely conservative estimate. The inherent flexibility of these performance standards will also mean that as designers develop expertise in working with BEPS, they will easily exceed the energy budget requirements. The BEPS budgets can be lowered accordingly, greatly increasing energy savings. In addition, BEPS allow designers and builders the flexibility to choose any number of conservation techniques to meet the BEPS energy requirements, and thus encourage creativity and innovation. The quality of our built environment will improve significantly reflecting this creativity.

When the Notice of Proposed Rulemaking was issued by the Department of Energy last November, the AIA Energy Committee formed a special Task Force to study BEPS. The recommendations of the Task Force, whose members are architects specializing in energy concious design, were presented to the Department of Energy during the public comment period on BEPS. I have submitted both our general statement and its technical back-up material to this committee and will summarize two important elements of AIA's response.

IMPLEMENTATION

The Institute has studied the BEPS implementation issue very carefully and recommends that a two-year phased implementation process begin immediately. This plan calls for a dual path approach using both building performance and component standards for a limited time. Specifically, our recommendations include the following:

- That BEPS be promulgated as currently scheduled.
- That the Department of Energy implement BEPS immediately-even before final promulgation in all 18 federal building types, throughout all geographic and climatic zones. (An Executive Order could initiate this important action now)
- That designers would be required to submit an annual energy use analysis of the building with each building permit (as required by BEPS)
- For no more than two years, local building officials could issue building permits upon receipt of this energy analysis even if it did not meet the energy budget requirements of BEPS; provided, however, that the design met all existing energy code requirements.
- At the end of two years, component (prescriptive) standards would no longer be used and all designs would be required to conform to minimum BEPS criteria.

This implementation plan, with federal buildings providing an immediate BEPS demonstration program, will also provide DOE the necessary time to refine the existing standards, and give the building industry experience in working with the standards before being subject to sanctions.

EDUCATION

An obvious key to the success of Building Energy Performance Standards will be the priority given to educating design professionals, builders, code officials and the public. We recommend that:

- DOE immediately undertake a comprehensive BEPS educational program
- DOE follow the recommendation of a General Accounting Office study and "expedite" its implementation plan working more closely with states and local jurisdictions on compliance procedures
- the BEPS educational process work in cooperation with all elements of the building industry.

The Department of Energy cannot assume the total responsibility for an educational program. As I mentioned, all elements of the building industry must share responsibility for this effort. In response to the need for educating the architectural profession, and a membership comprised almost entirely of small (ten or fewer total employees) firms, the AIA Board of Directors has made energy education the top priority of the Institute. We believe that our members will quickly respond to the design challenges BEPS will generate.

FURTHER RECOMMENDATIONS

We stongly urge Congress to ensure that the Department of Energy receive adequate staff and funding for the BEPS program. Congress authorized forty-three staff positions for BEPS. The Office of Management and Budget subsequently cut the number of positions to twenty-three and internal DOE shifts reduced this number to three. In comparison, the Department of Energy and the Department of Transportation employ over 200 persons to work on automobile efficiency standards. It is difficult to grasp the rationale of assigning only three professional staff to the BEPS program dealing with an industry that is significantly more complex than the automobile industry and with a program which will yield far greater energy savings.

To better respond to the urgent need for implementing energy conservation standards in buildings, we recommend that the government expedite the regulatory process perhaps through the immediate issuance of interim regulations (under the provisions of the Administrative Procedures Act). We also recommend that a similar "fast track" method apply to all outstanding BEPS support contracts. We cannot afford to be complacent; the current "business as usual" approach, surrounding all aspects of the BEPS program, must not continue.

Our national energy crisis is no less real because the long lines at the gas pump are temporarily absent. The United States currently imports nearly 50% of its oil; as DOE figures indicate we have allowed ourselves to become so dependent on foreign oil that from 1973 to 1980 the price rose 1000%. In the last 17 months alone, since December of 1978, oil prices have increased over 150%. A recent Congressional Budget Office report estimates that U.S. consumers will pay 142 billion dollars more for petroleum products by 1985 than they are paying now. The CBO further predicts that by 1990, oil prices will rise to 85 dollars a barrel. These ominous statistics emphasize the need for a strong and sustained commitment by Congress to address energy waste in the building sector. The cost of Congressional inaction on energy performance standards for new buildings will only increase our debts abroad and economic deterioration at home.

Neither the federal government nor the building industry have enviable track records in energy conservation in buildings. A Department of Energy report indicates that over half of the largest federal agencies increased their energy consumption in buildings from 1975-1978. In response to this excessive energy use and the failure to develop and implement Congressionally mandated energy conservation standards, Common Cause has filed suit against President Carter, the Department of Energy and the Office of Federal Procurement Policy. The suit also charges that DOE's failure to develop and implement a comprehensive ten-year conservation plan for federal buildings has wasted at least the equivalent of 31 million barrels of oil per day.

The private sector's recent response to the energy dilemma has been somewhat more heartening; however, energy inefficiency in buildings is still the norm. The Tennessee Valley Authority conducted a survey of newly constructed homes which showed that over 20 percent had no ceiling insulation and over 80 percent had neither floor insulation nor double-glazed windows. Obviously we cannot rely solely on the private sector to achieve our national goal of energy efficient buildings. The federal government must assume the leadership role in this essential energy policy partnership. By providing adequate incentives and standards, Congress can assure the building community's contribution to the alleviation of our excessive energy consumption.

There is controvery surrounding Building Energy Performance Standards and the AIA recognizes that legitimate concerns have been raised. But there are many more misconceptions about BEPS which we would like to address.

Many people have assumed that BEPS will have an adverse impact on the housing industry - an industry that has been devastated by our current economic problems - because compliance with BEPS will add to the cost of a new home and discourage potential buyers. The Department of Energy estimates that the maximum additional increase in the price of a "BEPS efficient" home will be $1500. This cost will be paid back by energy savings in anywhere from one to seven years, depending on fuel type. If the price of oil rises to $85 a barrel (or a 325% increase over today's price) by 1985 as the Congressional Budget Office predicts, the payback period will be substantially shortened. Even if compliance with BEPS added $3000 to the cost of a home, this initial increase in capital investment (with a 30-year mortgage and an interest rate of 11%) would increase the monthly mortgage payments by only $29 a month. Most homeowners, we are sure, will gladly assume this additional cost in return for greatly reduced fuel bills and a truly energy efficient home.

I would also point out that the root of the current housing crisis is economic - high and unavailable mortgages. It is not an energy issue and its resolution lies with Congress, the Federal Reserve and the Department of Housing and Urban Development, not with DOE. Delaying and diluting the Building Energy Performance Standards will not help the housing market; it can only hurt the consumer and weaken the national economy.

There has also been a great deal of criticism of BEPS on the basis that they are too complex for the building industry. We find this argument somewhat specious. DOE is presently devoting a great deal of time and effort to simplifying BEPS. The standards and the research on which they are based are technical and complex, yet this does not mean that BEPS will be difficult to put into practice. Many buildings are now being designed and built in all areas of the country which meet or exceed the BEPS energy budget requirements. Minnesota has conventional house designs which meet or exceed BEPS; California already allows a performance or BEPS approach to energy conscious design which has resulted in highly energy efficient buildings. The Institute is convinced that designers in any state will be able to work with BEPS in an equally effective manner.

To further address this issue of complexity we will submit to this committee an information sheet which we believe addresses many of the technical concerns that have been raised concerning BEPS.

Just as American consumers have become very energy conscious in their purchase of an automobile, so too are Americans becoming energy conscious when buying a new home - their largest purchase in a lifetime. The EPA provides a miles-per-gallon sticker rating on all new cars to determine fuel efficiency. Consumers have the right to expect a comparable, reliable "energy performance" projection on the buildings they buy or rent. BEPS provides just such a "sticker" rating in thousands of BTUs per square foot. Fuel efficiency determines the type of car we buy -- witness the success of the small, gas efficient imports. Fuel efficiency will be more significant in the purchase and rental of new homes and buildings.

In summary, we reiterate the Institute's strong support for BEPS and urge that the standards be promulgated on schedule. Further, we suggest that BEPS be implemented immediately in the federal building sector and that a gradual, phased implementation process begin for all new buildings as soon as possible.

While there is a clear abundance of energy rhetoric there is little evidence of a comprehensive national energy plan which will quickly, economically and safely address the energy problem. The Senate has recently given final approval to a multi-billion dollar synthetic fuels program which has a promising, but highly uncertain future. In contrast, BEPS will incorporate proven conservation techniques.

Energy efficient buildings must be a top priority for Congress and the Department of Energy with BEPS as the cornerstone. For its part, the building industry owes the country an honest effort to make the regulations work.

AIA offers its full support and assistance in the implementation of Building Energy Performance Standards.

Thank you.

THE AMERICAN INSTITUTE OF ARCHITECTS

PROPOSED RULE

ON

ENERGY PERFORMANCE STANDARDS
FOR NEW BUILDINGS

A STATEMENT BY
HERBERT EPSTEIN, FAIA
OF THE
AMERICAN INSTITUTE OF ARCHITECTS
BEFORE
THE DEPARTMENT OF ENERGY
OFFICE OF CONSERVATION AND SOLAR ENERGY

WASHINGTON, D.C.
MARCH 24, 1980

I am Herbert Epstein, FAIA, former Vice President and Chairman of the Energy Committee of the American Institute of Architects, currently a member of the Energy Committee Steering Group. Accompanying me is Mr. David Bullen, AIA, Executive Director of Energy Programs for AIA.

We are honored to be here today representing the AIA with the objective of advancing the Building Energy Performance Standards as a crucial element in achieving a nation of energy efficient buildings. The Institute has for many years supported the development of building performance standards and will continue to work closely with the Department of Energy to ensure their rapid implementation.

Our statement is offered as both a summary of our position and as a means to better understand the array of complex technical information we will be submitting for the record.

The AIA expresses continued support for building performance standards as one means of achieving energy-conserving design. In the last decade, energy standards have become a fact of life. We support the BEPS concept because of its advantages over prescriptive approaches. Some of the important opportunities and advantages of BEPS are:

- First, flexibility is built into the performance concept, allowing for innovation and creativity by designers.
- Second, technology is not frozen by the endorsement of one method or material over another.
- Third, relationships among building systems and components are recognized, allowing architects and engineers to design for greater potential energy savings.
- Fourth, improvements to such standards can be made easily by simply adjusting energy budget levels.
- Fifth, conservation measures can be accurately matched to building function.
- Sixth, the use of life cycle cost/benefit analysis is encouraged.
- Seventh, natural elements and renewable resources are recognized and their use encouraged.
- Eighth, the state of the art constantly improves through repeated application of the total performance process.
- Ninth, valuable consumer information on energy efficiency becomes available.
- And tenth, Energy-use information made available through the BEPS program is useful for meeting requirements of certain other government energy conservation programs.

We are submitting detailed material on: (refer to attachement A)

- I. Implementation of BEPS.
- II. Equivalency of other standards.
- III. Methods of compliance and enforcement.
- IV. Energy use weighting factors.
- V. Calculation methods.
- VI. Budget numbers.
- VII. Cost impact of BEPS.

However, we would like to summarize our thoughts on the most important of these issues.

I. Implementation of BEPS: The proposed rule addresses a very complex issue. Important problems still need to be solved. AIA recommends a two-year phased implementation period, during which time we believe the needed improvements can be made, workable standards produced, and technical and administrative capacity established.

The plan calls for a dual path approach, using both building performance and component performance standards for a limited period of time.

- BEPS would be promulgated as currently scheduled and made mandatory in all applicable jurisdictions.

- Designers would provide an annual energy use analysis of the building with each building permit application.
- For no more than two years, local building officials would issue permits upon receipt of this analysis, even if it did not meet the Energy Budget Level described in BEPS; provided, however, the design met all other existing energy code requirements.
- At the end of two years, the component performance standards would no longer be used and all designs would be required to conform to minimum BEPS criteria.

Such an approach allows for and stimulates the rapid development of more effective calculation methods. It also provides the necessary time to educate and improve the skills of all members of the building industry.

II. Equivalency of Other Standards: Research has shown that teams of architects and engineers are now designing buildings which are substantially more energy efficient than those being designed to meet the existing (nonBEPS) standards. AIA feels that there cannot be equivalency between a prescriptive or component energy performance standard and a total building energy performance standard. Many creative and low energy consumption building designs now are being rejected because they do not conform to existing prescriptive and component performance standards.

IV. Energy Use Weighting Factors: The AIA recommends that DOE make a change regarding the depletable fuel weighting factors used to calculate energy budgets. The proposed standards include weighting factors based on fuel source, cost, and value to the nation. The present method allows energy inefficient buildings to be designed in some regions of the country and also permits different levels of energy efficiency of buildings within the same region.

To produce a more consistent quality of building design, AIA recommends a dual budget that recognizes both building line energy use and source weighted energy use. A designer would be given two values based on the choice of fuel type; the more restrictive of the two budgets would have to be met.

V. Calculation Methods: As additions to the Standard Evaluation Technique, AIA recommends the development of reliable, inexpensive, easy-to-use energy consumption analysis methods for use by designers and code officials. Calculation tools and techniques must be created that match a wide range of design problems in terms of both scale and complexity. Those programs should be adaptable to hand calculator methods as well as micro and macro computer programs.

DOE also needs to develop a process of evaluation and certification of alternate methods for calculation of energy consumption.

Lastly, AIA would like to see additional administration procedures that provide for:

1. Phased implementation.
2. Simple methods for amendment.
3. An appeals process that can grant relief to cases of special hardship or innovative design and that can adjudicate reconsideration of building officials' decisions.

The Institute is aware that many groups and individuals will appear before this panel with lengthy criticisms of the proposed standards and recommendations for long periods of delay in their implementation. We would hope, however, that as the Department of Energy reviews the submitted comments it does not lose sight of the long-range benefits of the program through the design of better buildings. The issue of energy conservation remains paramount; this nation can ill-afford to ignore the energy that will be saved by utilizing performance standards.

It should be accepted that the best work of any group of knowledgeable people will not meet every need, condition, or concern -- nor will it satisfy everyone. But, we must move ahead -- we must continue to evolve.

The American Institute of Architects believes that Building Energy Performance Standards represent a major step towards national energy self-sufficiency and urge that these standards be implemented as rapidly as possible. We stand ready to assist DOE in the implementation process, as well as with future improvements or modifications to the standards.

Thank you for your time and consideration. We will be glad to respond to any questions.

(Attachment A)

THE AMERICAN INSTITUTE OF ARCHITECTS

PROPOSED RULE
ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS

SUPPLEMENTARY COMMENTS

by members of the
AIA BEPS TASK GROUP

to a statement by
HERBERT EPSTEIN, FAIA
of
THE AMERICAN INSTITUTE OF ARCHITECTS

before
THE DEPARTMENT OF ENERGY
OFFICE OF CONSERVATION AND SOLAR ENERGY
Washington, D.C. on March 24, 1980

APRIL 30, 1980

1735 NEW YORK AVENUE, N.W. • WASHINGTON, D. C. 20006 • (202) 785-7300

I. IMPLEMENTATION OF BEPS

IMPLEMENTATION/PHASING - (COMMENTS SET 1):

Strictly speaking, the issues on implementation and phasing of the performance standards are not the subject of this series of hearings. Another NOPR is expected this summer with an accompanying set of hearings to follow.

In order to develop an effective plan for implementation, we must first recognize the principal barriers or obstacles to be circumvented. With regard to BEPS, the chief difficulty is the necessity to estimate performance in order to demonstrate compliance with the standards. Methods of predicting energy performance in buildings are not widely known in the industry. As a result, calculation procedures (including DOE 2 and others) are clouded with much mysticism. This suggests an implementation strategy of encouraging or requiring design professionals to gradually become acquainted with methods of predicting annual energy use.

The problem is more than just unfamiliarity. Almost all widely used calculation procedures are undergoing constant development and refinement. Many methods are so complex that design professionals find them difficult to use. Others are abstract, ignoring important design variables, and thus the results are unreliable. New and improved calculation procedures need to be developed to facilitate implementation of BEPS. These should be as simple as possible, while producing reliable results. This requirement suggests that a specific calculation procedure might be limited to certain building types or climate zones, thus eliminating the requirement of universality.

The two key barriers to implementation of BEPS are described above: the learning curve of the building industry and the unworkability of current calculation procedures. What is needed to get around these barriers is an implementation strategy to simultaneously educate key members of the building industry while at the same time develop new, better and easy to use calculation procedures.

A method of accomplishing this was suggested in a paper which was presented to the May, 1979 Energy Committee Meeting in Denver titled: "The Case for Voluntary Performance Standards." It was recommended that, for certain classes of buildings, performance standards be implemented immediately along the following lines:

- An estimate of annual energy consumption would be required with each building permit application and compared with the non-mandatory energy budgets.
- The outcome of the estimate would have no bearing upon permit approval; however, the estimate would be verified as being reasonable.
- Responsibility for verification would rest with local code officials and the state energy agency. The state energy agency, with technical assistance from DOE, would establish criteria for reasonableness and disseminate information on recommended estimation procedures.
- Eventually compliance with the proposed performance standards would become mandatory. In the interim, however, existing codes or upgraded codes based on ASHRAE 90-75 should continue to be enforced.

An implementation plan as described above would force the building industry, code enforcement officials and state energy agencies to deal with the problem right away and would enable the most important issues to be addressed in an evolutionary manner without liability risks or over-concern with the adequacy of evaluation techniques.

The key to successful implementation of BEPS is a phase/gradual program carried out with deliberate speed. Large buildings, especially those which enjoy federal financing, should be included in this program immediately. At a later date,in perhaps six to eight months, all large buildings, say those over 50,000 square feet, should be included in the program. Later on other building classifications would be included and the performance budgets would become mandatory (also in a phased program).

We would expect many groups to respond to the mandates of preparing estimates of energy usage. Design professionals should certainly be leaders, especially in commercial building design; however, the utility, computer software vendors, heating contractors, manufacturers, and many others in the industry could be expected to make contributions.

The effort of implementation (preparing and checking energy usage estimates)would be positive work, fostering a greater understanding of energy flow in buildings and providing designers with valuable analytic tools to achieve energy savings far in excess of current expectations. New calculation procedures would surely emerge as a result of this effort--calculation procedures which are more usable and effective in achieving energy conservation.

Another benefit of this type of phased program would be that energy budgets and estimated usage data would become commonplace, and as a result, energy conservation would become a more important consideration for clients, lenders and lease holders. In some cases, the mere collection of data and its dissemination in the most effective channels can create strong pressure for change, i.e., energy efficient design.

Data from the required energy estimate would enable the current energy budgets to be evaluated and adjusted over the years. While the data would represent a sort of uncontrolled experience, with an endless variety of climates, building programs, and evaluation techniques, it would be very useful in making the subjective choice of where along the continuum to set the standards.

A precedent would be set for disclosure of the energy impact of new buildings, a precedent which might be applicable to other activities. Eventually the reporting might also include the energy required to construct the building as well as information on how to best operate and maintain the building.

The problems with calculation procedures will be gradually worked out as the building industry becomes accustomed to making estimates of annual energy usage. In the meantime, we would have improved our skills in designing energy efficient buildinings, generated valuable data for consideration by decision makers and developed new and improved methods of estimating energy usage.

IMPLEMENTATION - (COMMENT SET 2):

The above issues of design, education and enforcement all point to issues that must be addressed before, during and after the implementation of these standards. Views regarding implementation are as follows:

- Implementation of a building energy performance standard must be implemented as rapidly as possible. Failure to do so will increase our soaring energy costs and dependence on unstable third world areas. Delay of implementation of the standard will merely mean a delay in the key educational process and the involvement of design professionals, enforcement officials, and building owners in the energy conservation aspects of building design and construction. The government and the building community has for well over a decade been well aware of the contribution of the building community to energy waste and of the potentially disasterous consequences that increased energy consumption could have on the nation's economy and political stability. The Arab oil embargo of 1973 brought broad political and public awareness to energy matters. It is now 1980 and we are still debating the advisability of implementing energy conservation into the design process. Time marches on.

o Energy conservative design is not something that behooves instant expertise. Witness severe limitations in glass areas in certain codes - counter productive to the ability to naturally light and heat buildings.

IMPLEMENTATION - (COMMENT SET 3):

Two Year Phase-In

The proposed rule addresses a very complex issue and important problems still need to be solved. AIA recommends a two-year phased implementation period, during which time we believe the needed improvements can be made and workable standards produced.

We suggest that the plan call for a dual path approach, using both building performance and component performance standards for a limited period of time.

- BEPS would be promulgated as currently scheduled and made mandatory in all applicable jurisdictions.
- Designers would provide an annual energy use analysis of the building with each building permit application.
- For no more than two years, local building officials would issue permits upon receipt of this analysis, even if it did not meet the Energy Budget Level described in BEPS; provided, however, the design met all other existing energy code requirements.
- At the end of two years, the component performance standards would no longer be used and all designs would be required to conform to minimum BEPS criteria.
- Other phase-in concepts could be utilized parallel to the time phase-in approach, such as phase-in by code jurisdiction and/or phase-in by building size.

Such an approach allows for and stimulates the rapid development of more effective calculation methods. It also provides the necessary time to educate and improve the skills of all members of the building industry.

o Exception Process

The administrative process must include an appeal procedure to review and grant relief in cases such as unique building types, occupancy patterns or special hardship and to adjudicate reconsideration of building official decisions.

- **Continued Refinement**

  In supporting a building energy performance standard, the AIA fully recognizes that a large number of issues related to the promulgation of such a standard and its effective implementation have not been fully addressed. We strongly recommend that, especially during the initial implementation period, a very strong and active program of standards refinement be undertaken in addition to the mounting of a massive educational and calculation technique development effort. By its very nature, a building energy performance standard is a flexible and refineable device and should remain so even after the promulgation of such a standard as a code requirement.

II. EQUIVALENCY OF OTHER STANDARDS

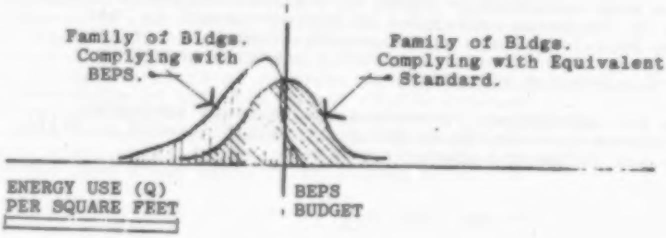
EQUIVALENCY - (COMMENT SET 1):

One important difference between component and total building performance standards is that the latter produces an estimate of annual energy use while the former does not. 90-75 should be upgraded so that it too results in a prediction of annual energy use.

Many advantages of implementing performance standards are lost unless as estimate of annual energy use is produced for each building. The production of energy use estimates would have the following advantages over current component approaches:

- Compliance with the standards would improve the state of art. As designers make estimates of annual energy use their understanding of the flow of energy of the building would be enhanced, enabling them to design better buildings with later opportunities.
- The estimates of energy usage provide valuable consumer information.
- The estimates would enable the performance standards to be interfaced with many other non-regulatory programs such as tax credit programs, etc.

In making a comparison between performance standards and the current component standards, with regard to energy saved, one must be careful to use a valid statistical approach. The criteria which has been implied for "equivalency" assumes that if a component standard produces buildings which on the average comply with the proposed budget, the component standard is equivalent. In reality, half of the building might use more energy that the proposed budget, while half might comply. See diagram below:


Family of Bldgs. Complying with BEPS.
Family of Bldgs. Complying with Equivalent Standard.
ENERGY USE (Q) PER SQUARE FEET
BEPS BUDGET

It is clear that for a component standard to produce energy savings on a national level equivalent to performannce approach, the average of a population of buildings complying with such a performance standard must be less than the budget level by some margin--perhaps one standard deviation. It is extremely important that this consideration be clarified in the public debate on equivalency.

A major issue under the topic of equivalency is the restrictive nature of many component performance standards. From experience, it appears that the California version of 90-75 is indeed restrictive in terms of daylighting. This is validated by several examples of fine energy efficient architecture. The state of California, for instance, has a new office building under construction in San Jose which is expected to use about 20 percent of the energy of a conventional office building designed in accordance with 90-75, yet this building does not comply with Division Four of the standard. The OTTV requirement is exceeded because the building utilizes more glass than is permitted, even though all the glass is shaded or oriented north.

In another example, an architect attempted to use a saw-tooth roof in a warehouse facility to eliminate the need for artificial lighting during the day. The vertical glass elements were considered skylights by the Energy Commission, and as a result the building envelope did not comply with the standard, since skylights are limited to 5 percent of the roof area. This particular design was abandoned because of an inadequate budget to make the necessary computer runs to justify the concept.

EQUIVALENCY - (COMMENT SET 2):

The AIA emphasizes that there can never be a prescriptive or component equivalent of a total performance standard such as BEPS because the energy consumption of a building is a complex, interactive system and cannot be dealt with simplistically in terms of its discreet parts. One of the basic principles of systems theory is that "the behavior of the whole (system) cannot be predicted from the behavior of its parts" - energy consumption or conservation not additive.

The AIA nonetheless recognizes the value of component performance standards as design tools and interim guideline for use during the phase-in period.

III. METHODS OF COMPLIANCE AND ENFORCEMENT

COMPLIANCE/ENFORCEMENT - (COMMENT SET 1):

Compliance/enforcement difficulties can be minimized through appropriate training programs, design manuals, etc., focusing on the needs of various members of the building industry.

ENFORCEMENT/COMPLIANCE - (COMMENT SET 2):

The key to successful resolution of the issues of enforcement and compliance is a comprehensive training and information program which addresses the needs of the industry during every phase of the building process. Such a training program will speed the development of energy efficient design procedures and minimize problems during the "plan check" phase.

To relieve some of the burden of building officials, it is recommended that design professionals submit affidavits with their estimates of annual energy use stating that - to the best of their knowledge - the proposed building is in compliance with the standard. To further assure compliance, the applications could be reviewed for accuracy on a spot basis.

COMPLIANCE - (COMMENT SET 3):

There are two major issues surrounding the proposed Building Energy Performance Standards, the numbers and what we do with them. Compliance deals with the issues surrounding what we do with the energy performance numbers.

A general issue which should preface any discussion of compliance with the Building Energy Performance Standards is an emphatic request that the standards be promulgated in as unambiguous and understandable a manner as possible. In my opinion, the NOPR was one of the clearest documents of its type that I have ever seen produced by the Federal government; yet, in reading through comments by individuals and organizations that have been following the BEPS project at one level or another during its years of progress, I find apparent misunderstandings of both the intent of the standard and the methodology of its implementation. I am certainly confused on a number of issues. It is apparent that an even more simplistic outline of what the standard means and how one goes about using it is necessary.

Specific issues within the area of compliance are as follows:

Design:

The design stage is the most important stage at which a building's energy performance will be set, save for the actual operation of the building itself. Significant changes in the design process will occur due to the implementation of Building Energy Performance Standards. Major impacts will affect the following:

o Teamwork:

A broadening and strengthening of the design team concept throughout the design process. All levels of the building design process - architects, engineers, landscape architects, planners, clients - must work more closely together at all phases of the design process from programming through post occupancy evaluation and must commit themselves to more indepth analyses of the various factors involved in the building design and use that will impact energy consumption and conservation.

o Professional Development:

The need for the broadening and intensification of the education and experience of all the design professions to allow them to rapidly develop expertise in the area of energy conserving building design. The greatest positive energy conserving impact that the BEPS standard may have is through its incentive to professionals to develop awareness of the energy issues that are impacted at the design stage, and a sharing of this information with the client in the form of operational suggestions. If the impact of BEPS parallels the impact of other standards (such as the ASHRAE 90-75), then it is quite possible that the anticipation of the imposition of such a standard will engender the necessary response from industry. If so, a number of mechanisms necessary to bring designs to compliance with the BEPS will already be in place by the time that the standard becomes a code.

o Design Tools:

The development and the use of tools for making design decisions relative to energy conservation will be rapidly expanded. These tools will take many forms; manuals of standard practice, articles, hand calculator and computer programs. Accompanying these tools must be an educational process that allows the user to understand how the tools may be used and apply them appropriately and correctly to specific projects. At the present time, many of these tools are sorely lacking; what tools are available do not always relate well to the true energy performance of a building designed through their use. The tools and reality must be addressed prior to successful application of Standards and the actual conservation of energy in new construction.

Enforcement:

The second element of compliance is that of enforcement of an energy performance standard. The building official - both at the local and regional level - will have to deal with negative pressures from both above and below his position. The political impediments to the adoption of a performance standard are made possible by the lack of an outline of the implementation process. The building official is used to dealing with a set of codes that do or do not allow a specific activity and finds his ability to deal with such specifics increasingly difficult as the issues grow and multiply in complexity. The flip-flop from a very specific compliance criteria to a broad and general compliance criteria is a difficult one for the code official to conceive of when faced with his necessity for a legal statement of compliance. He cannot always presume that a professional seal on the design documents is a certificate that the building meets all applicable codes and regulation; he is responsible for certifying the same. A great deal of education will be needed on the part of the building official before he will be comfortable in stating such compliance with a performance oriented standard. He will have a need for a set of evaluation tools by which designs may be judged.

Education:

Education will be the key to the successful implementation of the building energy performance standards at both the design and enforcement stages. This education must be both detailed and thorough. It must be directed at the major segments of the building industry; specifically the design professionals, (both individually as architects, engineers, planners etc., and as teams) the building enforcement officials, building contractors, building owners, product producers and building financiers.

IV. ENERGY USE WEIGHTING FACTORS

WEIGHTING FACTORS - (COMMENT SET 1):

The use of the Building Energy Performance Standards can maximize the use of renewable energy sources while minimizing the use of non-renewable sources.

To achieve these two objectives it is essential to produce the most efficient building design possible regardless of the energy source used. At the same time the standard could foster the use and efficient conversion to our more abudnant non-renewable energy sources.

The weighted budget numbers as published in the NOPR can in many instances be counter productive in achieving the above objective. For example, in regions of the U.S. where heavy heating loads are predominant and gas or oil are used for heating, the budget numbers permit the designs of buildings which are less efficient than current practice.

To achieve the full potential of energy conservation in all building, AIA has proposed a two part budget approach, consisting of building line budget and source energy budget. The designed energy performance of a building would be required to meet both.

The budgets as published in the NOPR, if adopted, could result in the following:

Consider a high school located in Boston, Mass. The budget as published is 121,000 Btu/S.F./Yr. If the building was designed for electric resistance heat and met the budget its building line energy use would be 39,285 Btu/S.F./Yr.

If we install a heat pump, the heating load could be increased by 120% and still meet the weighted budget of 121,000. Thus, the building could be downgraded significantly.

On the other hand if the heating fuel was gas, the heating load could be increased 146% and meet the budget of 121,000 Btu/S.F./Yr. With oil as the heat source, the building heating load could be increased by 92.5%.

According to section 3.2.8 of the NOPR, secondary schools had their budget set at the 50th percentile. The building line energy use of the example at the 50th percentile is 48,000 Btu/S.F./Yr. Then the gas heated school would be provided with a building line energy use 59% above the 50th percentile of the redesign and 6% above the original sample before the redesign. In the case of oil heat the building line energy use would be 40% above the 50th percentile of the redesigns and 6.6% below the 50th percentile of the original sample which was the state of the art in 1975-1976.

If the two-budget concept was used in this example, the building line budget would be 48,000 Btu/S.F./Yr. and the weighted budget would be 121, 000 Btu/S.F./Yr. The electric resistance heated school would be limited by the 121,000 Btu weighted budget and would have a building budget 18.2% below the 50th percentile of the redesigns. The electric heat pump school, gas heated, and oil heated would be regulated by the 48,000 Btu/S.F./Yr. building line budget. Respectively, they would be 14.7%, 23.4% and 19.1% below the weighted budget. This illustrates that to use electric resistance heat the building would be required to be 18.2% better than the other three and at the same time the heat pump, gas and oil building would be required to meet a tough standard.

Consideration should be given to adjusting the weighting factors to reflect the predominant source of energy in a given region. If the predominant source of energy for example were coal, the weighting factors should encourage its use rather than gas or oil.

WEIGHTING FACTORS - (COMMENT SET 3):

Two-Number Budget Required:

o The primary goals of BEPS and AIA are to:

  - maximize the use of renewable energy sources and

  - minimize the use of non-renewable energy resources

o The above goal requires two specific objectives. The first is to achieve the most efficient building design possible regardless of the energy sources used. The second is to foster the use and efficient conversion of our more abundant non-renewable sources when those sources are utilized.

o The single budget approach, however, can result in a mixed result of trade-offs between the above objectives. The present method allows energy inefficient buildings to be designed in some regions of the country and also permits different levels of energy design quality within the same region.

- To produce a more consistent quality of design and to achieve the full potential of energy savings, a two-part budget that recognizes both building line energy use and source weighted energy use should be used. The more restrictive of the two budgets would have to be met.

Weighting Factors Require Refinement:

The weighting factors and/or building line budgets require further refinement, especially relative to climatic differences. The impact of atypical climates do not appear to have been given adequate consideration in the generation of the specific budget numbers. The budgets are demonstratably inadequate in hot-humid areas where cooling/dehumidification is the major factor while they are overly generous (thus encouraging waste) in cold areas where heating is the major factor.

V. CALCULATION METHODS

CALCULATION METHODS - (COMMENT SET 1):

The development of easy to use, workable and accurate calculation methods is the key to the success of the performance standards concept. The standard evaluation technique as proposed has a number shortcomings, especially with regards to daylighting.

Another key consideration with regards to calculation methods is the procedure for certifying alternative techniques. With whom should the burden of proof rest? If architects or engineers must spend months testing their models and filling out forms, as is the case in California, there is little incentive and much disincentive for the development of alternative techniques.

CALCULATION TECHNIQUES - (COMMENT SET 2):

Calculation Methods Needed

AIA recommends the development of reliable, energy consumption analysis methods for use by designers and code officials. These tools and techniques must be appropriate to the scale and complexity of the project and the stage of design at which their application is intended. This appropriateness must extend to the price, ease of use and method of application (such as hand calculator, micro and macro computer programs).

Requirements of Calculation Techniques

Methods must address all forms of energy conservation techniques (passive solar, daylighting, mass, deadband, etc):

Calculation techniques must relate to reality:

- o Predicted results must be validated against actual building operation
- o Standard building operating conditions must parallel real-life conditions

Certification

DOE needs to develop a process of certification for alternate calculation methods.

CALCULATION TECHNIQUES - (COMMENT SET 3):

The section on compliance notes that the implementation of design tools to aid in the design in energy conservative buildings is critical to the success of the BEPS. These design tools will aid not only in the physical design of the building (their most important function) but will be required to assure compliance of the total building design with the building energy performance standard. The major issues that surround the development of tools, particularly calculation techniques are:

- The development of appropriate methods of calculation of designed energy performance.
- The process by which alternate methods other than the standard evaluation techniques can be certified as equivalent to the standard evaluation techniques for the purposes of assuring compliance of the building design with the building energy budget.

Development of appropriate methods:

Calculation methods must be development which are appropriate to the building type, scale and complexity. For instance, it is the considered opinion of at least a handful of individuals that using the standard evaluation technique to analyze small buildings such as residences makes about as much sense as killing ants with a pile driver.

- Appropriate methods of calculation of energy performance should be implementable through varied and appropriate means. Just as it may be inappropriate to use a large scale analytical process for a small scale problem, so may be it equally inappropriate to use large scale hardware systems for a simple analysis. Calculation methods must be developed that are implementable through manual and hand calculator methods, as well as micro and macro computer programs.

Certification of alternate methods:

A number of issues surround the certification of alternate methods. The following outline indicates concerns over the application of any calculation techniques and highlights current concern over the necessity for education, appropriateness, complete content and appropriate assumptions that will involve all evaluation techniques.

- User variation:

  The interaction between the person using the technique and the technique itself is not absolute. Misunderstanding on the part of the programmer who develops the evaluation technique as to the actual way in which energy is consumed in the building as well as the assumptions that a building designer would make during the design process may lead to inaccurate estimations based on very valid data. Conversely, the designer who does not understand the way in which the information which he inputs is processed may similarly experience a very poor evaluation of data that he thought was correct.

- Levels of certification:

  As pointed out in the preceding paragraph, different problems require different solutions. It seems appropriate to certify different methodologies for different building types, scales and complexity to insure that the evaluation process is not too simplistic for the problem at hand.

- Inadequacies of the current standard evaluation technique:

  It is necessary to pont out that the current standard evaluation technique is severely deficient in its ability to evaluate very energy conserving and appropriate design techniques. Particularly conspicuous in their absence are the abilities for the standard evaluation technique to consider daylighting, mass, passive solar heating and the impact of dead band on the energy use of the building.

- Standard building occupancy conditions:

  The development of a set of building energy performance standards default values appears to be an appropriate one in an attempt to obtain similar answers for similar building types. There appear to be at least two problems with the standard building operating conditions, the impact of which should be more thoroughly investigated.

First, the possibility that a building designed for the BEPS occupancy conditions which in fact must operate under an entirely different set of conditions will use more energy than if designed to its true operating characteristics. Some manner for accomodating this situation should be introduced as a part of the standard. An example of such a situation is a building that is designed for 24 hour occupancy, rather than 10 hour. To meet a BEPS standard for 10 hour occupancy, the building may have an entirely different set of equipment operating characteristics and internal gains than one designed for long period occupancy condition.

Second, some of the energy budget figures for both residential and commercial buildings seem considerably higher than currently achievable using good design practice. Experience has shown that many residential and commercial buildings do not currently consume the energies allowed by this standard, yet could hardly be called energy efficient. This disparity should be addressed by DOE.

VI. BUDGET LEVELS

BUDGET LEVELS - (COMMENT SET 1):

Budget Numbers and Weighting Factors:

Weighting factors can cause the proposed standard to be ineffective in those areas of the United States with a significant heating load. The buildings utilizing gas or oil as a heating fuel can be designed less energy efficient than some current practice and meet the standard, while an all electric building would have to be designed very efficient to meet the standard.

The budgets should be set in a manner which would cause all buildings to be designed as energy efficient as economically feasible, regardless of fuel type. It makes little sense to permit a building to waste energy simply because oil or gas is the heating fuel. A dual budget (building line and weight) with the designed energy use meeting both could solve the budget problem and permit the Standard to accomplish both goals of achieving maximum feasible energy savings and discouraging use of inefficient conversion of source energy.

If the diversity within a building type can be solved, then some of the types which are at R_{50} could have their budgets lowered to R_{30}.

Diversity of Buildings within a Classification:

Within given building classifications a very wide variation can exist in the building's use and its designed energy consumption.

For example "Gymnasium":

- Basketball arena seating 10,000 with a 60' interior height.
- A high school gym 24' high
- An exercise gym 12' high
- A natatorium

The impact of the envelope and ventilation load and lighting levels can have a significant impact on the design energy consumption. The exterior envelope can vary in area from less than 1/2 sq. ft./sq, ft. of floor area to more than 1 sq. ft./sq. ft. of floor area, thus the heat flow in or out through the envelope can more than double. Ventilation air required can vary from 1/3 cfm/sq. ft. of floor area to 1-1/4 cfm, thus the energy required could vary by as much as 400% for ventilation. It may not be possilbe to design a natatorium to meet the standard where a significant heating load exists and meet existing building codes.

Consider "Secondary School":

- A high school
- A vocational school
- An academic classroom building
- A laboratory building

An academic classroom building has significantly less energy requirements than many laboratory buildings or vocational schools. There needs to be a sub-breakdown within the secondary school types.

These two examples suggest that as the Standard is modified and improved in the future, consideration should be given to expanding the building classification or developing sub-groups.

AIA recognizes the necessity of setting budget levels for SFR- attached and detached by methods which differ from all other buildings but is concerned by the apparent disparity which exists between the SFR and MFR. For example, comparing SFR-A and MFLR for Columbus, Ohio, after adjusting to provide for the same energy use in each produces the following:

o An all electric MFLR unit can have 22.7% more energy than the same unit built as a SFR-A. For gas and oil the percentages are 46.2 and 84.8% respectively.

The domestic hot water is estimated differently for the two types. If we remove the domestic hot water from each, the comparison is all-electric, gas and oil respectively 74.8%, 157% and 113%. This suggests that the budgets for MFLR should be lowered.

The percentages are based upon utilizing total available weighted budget of 104,000 Btu/S.F./Yr.

Operating profiles:

Standard operating profiles to be used for widely scattered buildings become judgment decisions. It is necessary to use a standard profile in order to compare a design against a predetermined budget. This can, however, be resistive on design decisions when the designer knows the building will be operated totally differently and perhaps result in more energy conserving operation. The designer will be restricted for compliance purposes to a preconceived profile which may not match the actual building.

Given the large grouping of buildings within a building classification many of the profiles go into more detail than may be necessary. It is suggested that the predominant profile by used for determining compliance with the Standard.

Consideration should be given to approving profiles for specific projects which would match the actual design requirements of the project.

Locations of Established Budgets:

Consideration should be given to establishing budget for those locations which are not near a SMSA and where the method proposed for determining a budget would produce unrealistic comparisons.

NUMBER ISSUES - (COMMENT SET 2):

One of the chief concerns in this area relate to the differences in budget selection criteria for residential and commercial buildings. This difference can easily be illustrated by comparison of a single family budget with a garden apartment budget.

A comparison must, however, be made carefully since the single family budget includes only heating, cooling and hot water, while the multi-family budget includes all energy use including lights and appliances.

The source budget for a low-rise apartment building in Sacramento is 104,000 Btus/square foot per year. Of this amount 30,000 - 45,000 Btus/square foot per year would be used for lights and appliances. With this energy subtracted, the source budget for heating, cooling and hot water would range between 60,000 and 75,000 Btus/square foot per year.

The single family budget for heating and cooling is 22,300 Btus/square foot per year. If we add on about 25,000 Btus/square foot per year for hot water, we obtain a figure which can be compared to the multi-family budget--47,000 Btus/square foot per year.

The multi-family budget is actually larger than the single family budget by a factor of 30 to 60 percent. This is exactly opposite from what should be the case.

NUMBERS ISSUES - (COMMENT SET 3):

Discrepancies Between Certain Building Classifications:

A discrepancy in the selection of budget levels is the difference in levels set for single family residential and commercial buildings. The budgets for single family houses are lower on a square footage basis than garden apartments even though garden apartments are inherently more efficient. Other more subtle problems with the current budget level selection appear in other areas of the document and should be refined during phased-in.

SBOC (Standard Building Occupancy Conditions):

The Standard Building Occupancy Condition require further refinement during the phase-in period. It is very important that the occupancy condition to be used in the evaluation do not prescribe a building that may be inherently inefficient when actually occupied. Standard building occupancy conditions should relate to the level of evaluation employed during the building occupancy conditions should relate to the level of evaluation employed during the building analysis and should not be more complex than necessary for reasonable analysis of system performance.

Building Classifications:

The existing building classifications require refinement during the phase-in period. The current established building classifications are not broad enough to encompass the various sub-categories of building within any one general group.

HEALTH FACILITIES BUDGET LEVELS - (COMMENT SET 4):

The AIA Committee on Architecture for Health passed a resolution objecting to energy standards proposed for hospitals as presented in the Department of Energy Proposed Rule on Energy Performance Standards for New Buildings."

The Committee is opposed to the establishment of precise energy use limits based on information derived from a statistically invalid small sampling of hospitals, failure to utilze "state of the art"[1] procedures in determining actual energy use and the failure to recognize distinct categories for hospitals which by function may require higher than average energy use.

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1. "1 PHASE ONE/BASE DATA for the development of Energy Performance Standards for New Buildings." AIA Research Corporation, U.S. HUD, Office of Policy Development and Research, U.S. DOE TASK REPORT, Jan. 30, 1978, Page 6.

VII. COST IMPACT OF BEPS

COST IMPACTS - (COMMENT SET 1):

Implementation of a building energy performance standard is going to have cost impacts on building designers, contractors and owners. It is important to underline the fact that these cost impacts on the whole will be beneficial to all actors in the process. These costs will have positive and negative impact, but the positive aspects far outweigh the negative aspects of the cost impacts. The design professions recognize that there will be increased costs involved in the design and certification of more energy conservative buildings and the start up costs for design firms will be larger than will be able to be offset by increased fees. Many architects are willing to assume such costs for the benefit of society and the improvement of the professions.

I have divided the cost impacts into two broad areas: increased costs and the benefits of these increased costs.

Increased Costs

Increased costs fall into four basic areas:

1) Increased design costs:
Because more work will be necessary at the design phase, there will be an increase in the design costs for both residential and commercial construction. I would anticipate that the increase in commercial design costs will exceed that of residential, since the residential construction market frequently requires a repeatable building design, while the commercial field is more subject to unique design parameters.

2) Increased compliance certification costs:
In both the residential and commercial sectors, increased funds will need to be expended to assure building officials that designs have met the energy performance standards prior to the issuance of a building permit.

3) Increased construction costs:
In both the residential and commercial sector, there will be increased construction costs for materials and labor to institute higher levels of energy conservation. A certain number of energy conservation techniques will require a higher level of craftsmanship than currently employed in most of the residential and commercial sectors.

4) Short term adjustment costs:
At the inception of any new undertaking, there will be short term costs associated with start up. These costs include the costs of development of new methodologies and techniques, the education of the participants within the process and the costs of mistakes made during the initial stages of the new process. During implementation of building energy performance standards, there will

be a short term rise in the costs to the building designer, the building component producer, the builder, the enforcement official, the financial community, and finally, the building client.

Benefits of Increased Costs

Off-setting the above outlined increases in costs are the benefits that are derived from those increases in costs. By in large, every segment of the industry impacted with an additional cost will also receive additional benefits. Those incurring the largest increase in costs appear to be those that will reap the largest benefit. As an example, the producer of higher quality energy conserving products will have an expanded market for such products and the builder, especially those builders exercising a higher degree of craftsmanship on the job, will also increase their profit during the construction process. The building client will have the greatest cost benefit of all--a decrease in building operating costs over the life of the building. The people who tax the client and arrange his borrowing terms should recognize two very important facts. First, tax disincentives to the saving of energy are contrary to the purposes of [illegible] building energy performance standards and the national energy conservation goals. Second, the building finance community must recognize the ability of the client to support a larger first cost investment in the light of having lower continuing costs throughout the life of his facility.

COSTS - (COMMENT SET 2):

It is recognized that there will be an increased cost of building design and construction in the following four areas:

1) Increased design costs
2) Increased compliance certification costs
3) Increased construction costs
4) Short term adjustment costs

It is further recognized that design professionals will need to absorb a portion of the short term adjustment costs involving professional education. Many architects have emphasized their willingness to do so in the interest of national energy conservation.

It is recognized that off-setting the above outlined costs, there are benefits that are derived from these increases. Analysis performed as a part of the BEPS project show that the benefits outweigh any increase in cost expenditures. Moreover, the intangible benefits to the nation will increase the desirability of the building energy performance standards.

Senator **Durkin**. Mr. Carter.

STATEMENT OF DONALD G. CARTER, CHAIRMAN, NATIONAL ENERGY COMMITTEE, AMERICAN CONSULTING ENGINEERS COUNCIL, ACCOMPANIED BY STEVEN L. BIEGEL, DIRECTOR OF ENERGY PROGRAMS

Mr. **Carter**. Mr. Chairman, members of the subcommittee, my name is Donald G. Carter. I am a consulting engineer, owner of Carter Engineering, Inc., in Silver Spring, Md.

And I appear before you today on behalf of the American Consulting Engineers Council as chairman of their national energy committee.

Accompanying me this morning is Mr. Steven Biegel, director of energy programs for the council and a registered architect.

We are delighted to share this panel with Mr. Ed Riddick, representing the National Society of Professional Engineers; Mr. Gerry Jones, representing the American Society of Heating, Refrigeration and Air-Conditioning Engineers; and Mr. C. R. Erlandson, representing the Air-Conditioning and Refrigeration Institute.

Each of the named representatives has brief remarks on behalf of their respective professional societies.

I will be brief and provide you with only the most relevant comments on the proposed building energy performance standards.

Our council supports the concept of developing useful and well-considered performance standards for energy conscious design.

We have expressed this support at previous public hearings, and we have supplied the Department of Energy with technical advice and assistance during the development of the present BEPS proposal.

Many of our concerns are on record with DOE as a result of the six regional hearings completed in April of this year.

ACEC testified at all six regional hearings, during which we pointed out the serious flaws contained in the proposed standards.

Such flaws are numerous and we could not begin to list the entire range of problems contained in BEPS without consuming a great deal more time than is allotted at this session.

For this reason, we call your attention to our detailed analysis of BEPS, and ask that this 98-page document be included in the formal hearing record.[1]

Senator **Durkin**. It will be.

Mr. **Carter**. In addition to helping DOE identify specific problem areas, we recommended procedures and revised language to remedy many of the deficiencies now present in the BEPS proposal.

It is our sincere hope that DOE will accept our constructive criticism and revise the standards accordingly.

Our members are primarily concerned with the extremely ambitious schedule prescribed in title III of Public Law 94-385, the Energy and Conservation Production Act of 1976.

We believe that to require the Department of Energy to produce a final BEPS by August 14, 1980, is totally absurd.

In addition, the specified 1-year implementation requirement following the date of final promulgation is ill considered and does not recognize the need for State legislatures and/or municipal govern-

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[1] See appendix VIII.

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ments to enact measures to embrace the BEPS and incorporate them into existing State and local building codes.

This is a serious problem as it may take many years to develop the necessary confidence in this new set of regulations to enable designers, code officials, developers and others to actively use them and successfully reduce energy consumption in new buildings.

The BEPS have not yet been tested through the actual design and construction process to verify the simulations conducted with computers during the standards development.

The imposition of what amounts to our Nation's first federally mandated national building code is a very serious and sensitive subject.

Such a standard, if it is to establish this precedent, must be thorough, well considered, easily understood, easily adaptable to current practice, practical and completely tested.

As it stands today, the BEPS is none of these things.

There are organizations and individuals who have charged that our concerns about BEPS are specious.

In response to this, I wish only to point out that the entire construction industry, including homebuilders, developers, State and local building code officials, realtors, labor groups, material suppliers and manufacturers, building owners, managers, and professional engineers, all agree that the current BEPS proposal is incomplete, overly complex, and largely unsubstantiated.

There is nothing showy about this situation. As a matter of fact, the National Institute of Building Sciences, the body specifically created by Congress to provide relevant information on the design and construction industry, has supplied key congressional leaders with a suggested schedule for completing ongoing research and revising the standards.

NIBS has recognized, with the aid and assistance of the industry, many shortcomings contained in the DOE proposal.

NIBS, with cooperation and support from the industry, prepared a lengthy and detailed assessment of the proposed rule.

As NIBS has stated this morning, their report is a complete and comprehensive industry response to the BEPS proposal.

Understanding the many flaws contained in the rule, NIBS has developed and proposed a revised schedule for finalizing and testing BEPS which permits voluntary implementation of the standards over a 2-year period.

We are extremely pleased to note that you, Senator Durkin, have introduced a bill to amend the Energy Conservation and Production Act to provide for a realistic schedule for the promulgation and implementation of BEPS.

Our council applauds this initiative because S. 2862 goes far beyond the simple 2-year extension passed by the Senate on June 21.

The Durkin bill is largely consistent with the NIBS proposal, and would authorize congressional veto power over the entire standards-making process if BEPS proved to be invalid after a 2-year demonstration period.

Our council expects that effective implementation of BEPS as required in Public Law 94-385 will require at least 5 years to achieve.

On an accelerated schedule, a usable standard could be developed and testing could begin in 2 years.

For this reason, we believe that the recently passed 2-year extension is a step in the right direction. However, the measure does not go far enough toward requiring DOE to select specific locations, specific building types and other parameters to test the standards beyond the already mentioned computer simulation.

In addition, DOE should be required, through a series of periodic oversight hearings much like this one, to report on their progress and findings during a carefully controlled and monitored demonstration effort.

It is clear in our minds that any attempt to implement BEPS now in their present form will result in the failure of the program and the wasteful expenditure of millions of dollars.

The issue of the BEPS schedule is the overriding concern to all of us as additional time will permit the resolution of many serious flaws in the standards.

Yet, there are several important issues which merit your attention at this time.

A primary concern to the design professionals is the issue of design liability implied by the imposed rule.

In short, designers are not insured through the traditional professional design liability insurance program to perform special certifications related to specific building codes and standards.

ACEC and other professional organizations have worked closely with the two major design liability insurance carriers to develop language to minimize liability exposure for such certification.

DOE has been involved in these meetings. However, no final language has evolved to expressly eliminate the risk to design professionals suggested by the standards.

This is an extremely serious point.

DOE should conduct a thorough analysis of this problem and revise the standards accordingly.

In addition, we find it difficult to believe that no study was conducted of the additional design time requirements necessitated by the new standards.

As has been the case with other Government regulations, additional time spent behind the drawing board is an additional cost burden on the designer and, ultimately, to the client for whom the designer is working.

Today, DOE has developed no firm information on potential design time increases.

Our council, based upon an informal survey of consulting engineers involved in the design of energy-efficient facilities, projects design time increases resulting from BEPS to be 10 to 40 percent over contemporary engineering practice.

This translates into additional fees for designers of the same magnitude.

However, we believe that the energy savings which result from application of the BEPS proposal will not offset, first, costs for additional design time, plus additional construction materials and labor, plus costs of implementation and enforcement from tax revenues.

There are some important interesting cost figures which should be considered at this point.

DOE has estimated that implementation of BEPS through the State building code and compliance system will require approximately $1 million per State initially.

This projected $50 million investment combined with the already expended $32,818,000 for research and development brings the total price tag for the rulemaking and implementation process to $82,818,000.

Senator **Durkin**. That is about 40 small-scale hydro sites, the equivalent of 40, that would be generating power within 1 year.

Mr. **Carter**. That's an interesting number.

In addition, DOE has projected cost increases for new home buyers to approach $1 a square foot or an additional $1,800 for average residence.

Commercial space cost increases are projected by DOE to approach 5 percent of the total construction cost.

Our council believes that the DOE cost projections are extremely conservative.

We anticipate total project cost increases to be at least 100 percent higher than the DOE estimates.

The total potential economic impact of this one Federal rulemaking is staggering.

To further illustrate our arguments on BEPS, we bring to your attention a portion of the legislative history of title III of Public Law 94-385, wherein appears the original congressional expectation for energy savings resulting from the implementation of BEPS.

In 1976, the conference committee report concerning BEPS stated:

> It is estimated that the Federal Energy Conservation Performance Standards for new residential and commercial buildings, if fully implemented, will alone account for energy conservation savings of up to 6 million barrels of oil per day by 1990.

The Department of Energy, after 4 years of intensive research and a total Federal expenditure of $32 million has concluded that BEPS could save only 216,000 equivalent barrels of oil per day by 1990 if fully implemented.

This is less than 4 percent of the original estimate on which the need for these standards was based.

In summary, there is very little confidence among our members that the BEPS initiative is worth the expense and effort.

However, at a time when conserving energy is extremely important and a critical issue affecting our economic stability and our national security, we must explore every avenue of potential energy savings.

The BEPS undertaking should be considered further. We should not abandon the BEPS effort even though the value of the program seems minimal.

In our effort to salvage the BEPS program, we must be cautious and attempt to avoid hastily developed and imposed standards.

This is why the Durkin bill makes good sense. The construction industry is both enormous and fragmented.

To impose an untested set of standards which are hastily imposed will only cause disruption within an already depressed design and construction industry.

The BEPS must be revised and tested in a real world situation.

The American Consulting Engineers Council says slow down, proceed with caution, take extreme care to determine the actual benefits of the program rather than the potential benefits.

As our colleagues from ASHRAE will point out, there are energy standards for new construction which have existed for many years, successfully saving large quantities of energy.

ASHRAE standard 90 is familiar to all engineers, and should be considered a viable substitute for BEPS during the many years of development and testing which lie ahead.

Thank you for this opportunity to appear. I would be happy to answer any questions after the panel has spoken.

Senator DURKIN. Thank you.

Mr. Riddick.

STATEMENT OF EDGAR K. RIDDICK, JR., CHAIRMAN, SUBCOMMITTEE ON ENERGY CONSERVATION AND MANAGEMENT, NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Mr. RIDDICK. I am Edgar Riddick, a consulting engineer from Little Rock, Ark. I am speaking officially today on behalf of NSPE, the National Society of Professional Engineers.

Our society endorses the testimony that you will hear from the other members at the table.

I, personally, have had over 25 years of experience in building design and over 10 years directly related to energy conservation.

Over the last 5 years, I have worked representing the National Society of Professional Engineers, closely with HUD, FEA, ERDA and, more recently, DOE in an effort to bring some sense into the productions required by Public Law 94-385.

I probably was selected to present the well thought out and very carefully developed position of the National Society of Professional Engineers because I am very deeply and emotionally involved in this issue.

And my remarks will not be directed toward delineating the deficiencies that we see since those deficiencies have basically been outlined in our written testimony and have been clearly outlined by a number of others.

I think that, to paraphrase, Senator Durkin, your remark in the summary on your recent Senate bill S. 2862, we, the national society, feel strongly and strongly believe that improved energy productivity and efficiency must be one of the Nation's top priorities.

However, we oppose this cumbersome Federal regulatory approach.

I would like to say that over the 5 years working closely and frequently with the Department of Energy, that we have found the staff members that we have worked with to quickly understand the deficiencies that you will hear today and which I will not repeat.

But what has happened is that we have been told over and over that these deficiencies were understood and something was going to be done about them.

And, repeatedly, the new drafts come out and no recognition is made of it. And it leads us to have very little confidence in what is going to happen in the future.

The engineering societies are in almost total agreement in their position. The Coordinating Committee of Energy which represents over 800,000 engineers, essentially, has endorsed all of the testimony here and previously as the points have come up at other times.

We are not divided and, yet, we are, we feel, really not listened to.

We get very kind reception. We have pleasant meetings, but we see no results.

Now, one of the terrifying things about it is that we are convinced that if the BEPS are implemented as they now are, including the weighting factors, that the actual result will be to encourage more use of imported oil and of natural gas.

One—on a one-to-one confrontation, many times, I have been challenged on this, and can sit down, as many engineers can, with a pencil and computer now—instead of a slide rule—and demonstrate this.

While, in many instances, BEPS will result in saving in energy, there are many, many buildings due to the mix of different types of energy that are actually allowed to increase their consumption of energy.

And we feel that, to implement the BEPS, when the net result would be to override, in effect, prescriptive standards essentially based on the ASHRAE standard 90-75 in 44 States, would really encourage more use of energy.

And we feel like we can prove this on paper. We have done it whenever we are asked and, yet, nobody listens to us.

Senator **Durkin**. You know, we have seen the problem in the Federal building in Manchester. It can be 70 degrees outside and, on the seventh floor where our offices are, it will be about 85 in the spaces, and you can't open the window.

If you open the window to let in the cool air that is out there, a light goes on on a panel and someone comes up to find out which window is open. The staff finally took a church key, a beer opener, and figured out a way to open the windows.

I mean, it would be like a sauna bath in there and beautiful outside, and you couldn't open a window.

Mr. **Riddick**. As one other example—and I am not trying to mislead you or smokescreen the issue—I could provide examples that support BEPS.

But just to show you that it can go either way, in region III which includes Pittsburgh, a typical office building by the AIA research data, which was supposed to show good design for 1975—allowed an office building to use 65,000 Btu's.

Now, the phase II data which was developed under the BEPS program, and which is basically good data as far as it goes, showed that this could be reduced to around 40,000. Now, that's great.

Also, the notice for proposed rulemaking indicates in it, in writing, that ASHRAE 90-75R, revised, comes within 2 percent of that number, when that's basically a prescriptive standard.

And, yet, I can take the BEPS and design an office building in Pittsburgh that will use over 100,000 Btu's and meet the code. That is what we are talking about. Now, I won't go into any more detail on that.

Another example is that there is no provision in the BEPS to handle unique buildings. And the classic example I use so often is two hospitals in the same city; one has 25 operating rooms and 500 beds and the other has 1 operating room and 50 beds. There is no way they use the same amount of energy or need the same amount of energy.

The BEPS makes absolutely no—not only doesn't it recognize it, but there is no procedure to handle it, which makes it unworkable.

That is just one example. You could pick many buildings.

Another point is that there is the complaint that the prescriptive standard which now is in effect in over 44 States does not allow the designer to have flexibility.

This is an out and out misrepresentation by omission because chapter X of ASHRAE 90-75 gives exactly the same flexbility as the BEPS. That is a misrepresentation of facts by omission.

Senator DURKIN. You know what concerns me—you know, the old saying that a camel is a horse designed by a committee.

I am wondering if we are not headed down that route with, again, moving toward national standards. It's a great goal, but I'm not sure it is practical.

Mr. RIDDICK. Well, let me say one thing directing toward that. A standard, by definition, is not supposed to do anything but present the facts of how to accomplish something technically.

And that is what the prescriptive type of standard, 90-75, does.

Now, on the other hand, the weighting factors injected in that put national policy on pricing, on the amount of imported oil. They inject that into the standard.

Now, I'm not against the Government controlling national policy when matters of defense and security are concerned, but they have no place in a standard. They should be addressed appropriately for what they are.

You simply cannot mix the two. And on that basis and on the basis that the weighting factors make the standards ineffective, they are definitely not appropriate in the standards.

Senator DURKIN. The problem is that you have got to get up and turn on the "Today Show" to find out what national policy is for the day. [Laughter.]

Mr. RIDDICK. Well, that's another reason why they shouldn't be included in a standard. They change every day.

Now, I will conclude. I simply want to say that the National Society of Professional Engineers does not support BEPS as they now stand. We believe they will take 2 to 5 years before they can be brought into a proper form.

We believe that an alternate path must absolutely be established, another way to go, a prescriptive way.

We do support the provisions in the Senate bill S. 2862 because it outlines essentially what we are supporting.

We do wish to point out that the standard evaluation technique upon which determination of compliance with BEPS is supposed to be based is not a definition of a technique. It is a discussion of a technique.

And, at the moment, there is no way, except running a DOE-2 program, to determine whether a building meets the standards.

We feel like that more answers should be given to supporting the existing States that have prescriptive standards.

We feel like that people should stop trying to defend those parts of the BEPS that everybody agrees are inadequate.

Pick the best parts, combine them with what we have and go ahead.

And we hope—and as the attorneys say in court—and we pray that the Government will listen to the engineers and at least recognize their contribution into this which has been very extensive. Thank you.

[The prepared statement of Mr. Riddick follows:]

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS
"Putting It All Together For The Engineer"
NSPE

STATEMENT ON THE PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS
TO THE
SUBCOMMITTEE ON ENERGY REGULATION
COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE
JUNE 26, 1980

Edgar K. Riddick, P.E., Chairman
Subcommittee on Energy Conservation
and Management
For the National Society of Professional
Engineers

INTRODUCTION

This statement is presented on behalf of the National Society of Professional Engineers, an organization comprised of some 80,000 professional engineers representing all areas of employment: industry, government, education, construction and private practice. It represents the combined thoughts and attitudes many of them have developed over the past many months with respect to the proposed Building Energy Performance Standards, and years with respect to previously developed standards. It also reflects the combined wisdom of many years of professional practice.

It must be said at the outset that the National Society of Professional Engineers is and has been on record supporting not only energy conservation but also the development of new sources of energy. Today, of course, we focus our attention on conservation. Our goals are identical to those of the Department of Energy and, we assume, all others participating in this process. Energy conservation must be achieved. The question is how that goal can be accomplished.

I hope the Committee understands clearly that although this statement will not cover the issues my colleagues address in their respective statements, we in NSPE fully support the views expressed by representatives of the American Society of Heating, Refrigerating and Air Conditioning Engineers, the American Consulting Engineers Council and the Air-Conditioning and Refrigeration Institute. I am pleased to report that the engineering community, disjointed as it may appear to the outsider, is in virtually total agreement on issues related to the Building Energy Performance Standards. Individually and collectively we have identified a veritable laundry list of unanswered questions in BEPS as proposed. I will address only a few of these issues.

At the outset, it must be made absolutely clear that there must be a delay of at least two years in the promulgation of the Building Energy Performance Standards proposed by the Department of Energy. I want to also make it clear here that in calling for such a delay we are not condemning the Department of Energy or its staff. The Congress gave the agencies (Federal Energy Administration and Department of Housing and Urban Development) a difficult task with P. L. 94-385. It was unfortunate that the Congress, at the time P. L. 94-385 was enacted, did not take greater cognizance of the then existing ASHRAE Standard 90-75. I need not remind you that this standard has become the basis for energy conservation standards associated with new construction in some 45 states. It is accepted. It is functional and it is effective. You should also be aware that it has taken some five years or more for this standard to achieve the present level of acceptance. The same time period should be anticipated for any other standard, i.e., the proposed BEPS. Imposition of BEPS without recognition and acceptance of ASHRAE 90-75 can only impede improved energy conservation in new buildings.

Now, allow me to turn to specific issues. I will, in the following pages, address several issues which we of the National Society of Professional Engineers believe to be paramount. They are: delay of implementation, weighting factors, application to unique buildings, energy conservation itself.

Delay of Implementation

Virtually every criticism of the BEPS as proposed lends further weight to the fact that their implementation should be delayed. The substance of these criticisms demands that additional time be expended in raising BEPS to the professional and technical level we all legitimately expect of it.

Some of the key criticisms include strong questions as to the validity of the design energy budgets themselves, which reflect on the quality of the research upon which the budgets were structured; the Standard Evaluation Technique as proposed is quite inadequate; the proposed weighting factors impose a national energy policy which is inappropriate for inclusion in a building standard; there are serious unanswered questions regarding liability of designers and builders; the economic impact on designer, builder and owner has not been satisfactorily considered.

There is only one answer to these and the other issues of substance - and I emphasize substance - and that is to delay the promulgation of the BEPS for at least two years thus permitting opportunity for resolution of the questions.

I can assure you that should the BEPS be promulgated and implemented as presently proposed, the results will be disappointment at best. They are not ready for implementation. The Department of Energy has recognized this fact itself in recent testimony. What the DOE does not recognize, however, is that six months or a year is not sufficient time in which to correct a bundle of problems which required three or four years to create or identify. DOE is much too optimistic. NSPE believes two years is an absolute minimum extension.

If we can't do this job right, we would be better off not to do it at all.

Weighting Factors

The Department of Energy has, intentionally or otherwise, undertaken to turn a building standard into a document which establishes national policy with respect to energy source. Not only has the DOE misread its responsibility in this regard it has also charted a national policy detrimental to national welfare. Allow me to trace the steps that got us into what could have been an embarrassment to the United States.

The Advanced Notice of Proposed Rulemaking (ANOPR) published in the Federal Register on November 21, 1978, proposed that as a part of the BEPS Resource Impact Factors and Resource Utilization Factors (RIF's and RUF's) be utilized. DOE, as stated in the Notice of Proposed Rulemaking (NOPR) (2.4.1., DOE's Decisions on Weighting Factors) "decided to reject both the use of RUF's and RIF's and the use of weights that would effectively value all forms of energy equally at the building line." However, DOE went on to state that, while both (RIF's and RUF's and Design Energy Budgets expressed in terms of Btu's of energy used at the building boundary) would weigh the consumption of fuels "neither would take adequate account of social or policy considerations." "Thus the scarcity value of fuel would be ignored as would the true cost to the nation of consuming certain fuels. Also, such weights would be unable to reflect such important concerns as the national security cost inherent in becoming more dependent upon imported fuels."

P. L. 94-385, in defining the purposes of BEPS in Title III, states that the purpose is "to insure that reasonable energy conservation features will be incorporated into new commercial and residential buildings receiving Federal financial assistance, provide for the development and implementation .... of performance standards .... designed to achieve the maximum practicable improvements in energy efficiency and increase the use of nondepletable sources of energy and encourage states and local governments to adopt and enforce" the standards. We find no reference here to a responsibility that DOE's BEPS "take adequate account of social or policy considerations."

A building energy standard - any building standard - relates to the building and only the building. Public Law 94-385 called upon the Federal agencies to develop a building standard. It did not instruct those agencies to develop national policy relating to the use of various energy producing fuels. The BEPS weighting factors reach into the public policy arena which is outside the function and purpose of the standards. Further, as will be demonstrated later, these weighting factors do in fact permit the use of more - not less - energy in numerous instances.

Our basic opposition to the weighting factors concept is philosophical. As noted above, a building standard is just that. It is not a tool for establishment of national policy. RIF's and RUF's and weighting factors lead to the attempted institutionalization of social and policy issues with a building standard. The mix is inappropriate and illogical. It is far outside the Congressional intent as expressed in P. L. 94-385.

Application to Unique Buildings

As used in this context "unique" does not refer only to "one time only" structures or those designed to house functions totally uncommon to patterns of life. The issue is founded on the question of the validity of the research data utilized for the development of the BEPS.

I quote from the comment on the proposed BEPS developed and submitted by the National Institute of Building Sciences which, in providing these comments, was performing its Congressionally mandated function. NIBS said, in part:

"The National Institute of Building Sciences (NIBS) in its own review of the Statistical Analysis technical support document, questions the statistical representation of the Phase I and Phase II research, particularly with respect to whether or not the 168 buildings selected in Phase II are a sufficient sample size for analysis.

"When broken down by building type and energy consumption characteristics there remain only one or two observations per cell. A small sample sito such as this not only inhibits the range, and hence representation, of buildings to be tested, but also limits the degree of stratification possible for building types. For example as stated in the technical support document, 'The size of the sample is too small to allow for further stratification by building size.' Such stratification would provide for greater detail and reliability in the analysis.

"A basic question, therefore, is whether the small number of 'observations' made causes a bias in the sample by giving greater attention to and relying most heavily upon one or two buildings as being representative of a larger, more diverse universe. It has been suggested, for example, that the sample may be skewed towards larger buildings while at the same time not really being representative of either small, medium or large buildings. ......

"Similar concerns appear to be held by the National Bureau of Standards as reflected by its recommendation that DOE 'drop claims of statistically based results in favor of professional judgement and analysis for interim approach, then consider proceeding to develop and evaluate feasibility of minimum life cycle cost approach for commercial buildings." (emphasis added)

Such observations are not dreams. They are based on real life situations. I offer the following as one such example. In our example we use a small satellite hospital and a central tertiary referral hospital, both in the same community and hence in the same climatic zone. Both are, obviously, hospitals and therefore fall into the same building category. At that point, however, their energy utilization similarity ends. The larger facility, the tertiary hospital, with a much heavier loading of operating rooms and ancillary facilities would require a much higher energy budget than would the satellite hospital dominated by a higher loading of patient rooms. Patient rooms are substantially lower in energy consumption than are operating rooms and the associated service facilities. There is within the BEPS no mechanism by which this conflict can be resolved. A procedure for addressing special cases - and there will be a myriad of them - must be developed if the standard is to be at all effective and practical.

Energy Conservation

Finally, I want to address the basic question of actual energy conservation. This standard - as proposed - actually permits consumption of more energy in new buildings than was the case in 1975 when design criteria for energy utilization was subject to such vagaries as negotiations between the building owner and the design professional. While BEPS may be a form of energy performance standards, it is in this instance by no means a path towards energy conservation - which is the stated goal. It is the application of the proposed weighting factors that leads to the development of a standard which produces these shocking results.

The following is illustrative. Data in the AIA Research Corporation Phase I study shows that the mean consumption of energy in a large office building in Region III (Pennsylvania, Delaware, New Jersey, Maryland, and the District of Columbia) was 65,000 Btu's per square foot per year. The BEPS as proposed permits 112,000 in Pittsburgh, 117,000 in Philadelphia, 116,000 in Newark, and 115,000 in Washington, D. C. These results are achieved by application of the weighting factors.

Summary

It should be recognized that many of the concerns expressed here are not new. They have been expressed in other forums by ourselves and others. Many, in fact, were first expressed in detailed form by the Technical Advisory Group (TAG) to the AIA/Research Corporation during and after completion of that body's research effort leading to the development of BEPS. Membership on the TAG consisted of representatives from the American Consulting Engineers Council, The American Institute of Architects, the American Society of Heating, Refrigerating & Air Conditioning Engineers, Illuminating Engineers Society of North America, National Society of Professional Engineers, National Association of Home Builders and the Manufactured Housing Institute.

TAG raised serious questions as to the data base and the data which evolved therefrom. TAG recognized the significance of the fuel equivalency question. It stated in its report, "The TAG discussed, in detail, fuel equivalency and agreed that no acceptable equivalence factors now exist. Some members of the Group believe the issue should be avoided and the problem of conversion deficiencies treated in a separate research effort."

TAG expressed concerns as to the enforceability of BEPS. The report read, in part, "The TAG expressed deep concern for the enforceability of performance standards; both the ability of the design team to use them appropriately and the ability of the regulatory agency to implement them, particularly in light of the limitation of currently available analytical tools."

TAG also recommended a number of issues deserving of further research. That list itself makes it abundantly clear that we are not ready for the promulgation of BEPS as we now know it.

I thank you for the opportunity to appear before you today and would be pleased to respond to questions you may have on this very important issue.

SENATOR DURKIN. Dr. Jones.

STATEMENT OF DR. JEROLD W. JONES, CHAIRMAN, ASHRAE BEPS RESPONSE COMMITTEE, AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

Dr. JONES. Senator, we appreciate the opportunity to appear today. I am speaking on behalf of the American Society for Heating, Refrigerating and Air-Conditioning Engineers, ASHRAE.

Because ASHRAE has previously commented extensively on BEPS, the statement that I will deliver today will address the specific proposed program changes that were outlined before this subcommittee by the Department of Energy on June 5.

I am Dr. Jerold W. Jones. I am an associate professor of mechanical engineering and director of the conservation division of the Center for Energy Studies at the University of Texas at Austin. I am also a registered professional engineer.

I have been chairman of ASHRAE's BEPS Response Committee and I served as cochairman of the AIA Research Corporation Technical Advisory Group working with the BEPS program.

ASHRAE is a research-oriented voluntary association of some 40,000 members who have professional concerns with heating, cooling, ventilating and refrigeration in buildings.

The members of ASHRAE are both knowledgeable and experienced in the development and implementation of energy standards for new and existing buildings.

ASHRAE has previously testified on the history of the development of its standard energy conservation in new building design.

I offer copies of that comment and testimony for inclusion into the record in this hearing.[1]

Senator DURKIN. It will be included.

Dr. JONES. Thank you. ASHRAE is gratified by the care and concern that the Department of Energy seems to be taking in responding to many of the comments submitted on the proposed BEPS rule.

We commend DOE for moving to revise its schedule and for recognizing the need of incorporating into revised proposal many of the modifications suggested in the public hearings.

Although ASHRAE recognizes the value of the revised BEPS plan, we have several major concerns which remain. These fall into two basic categories: the time required for completing the development and implementation of BEPS and the question of establishing an equivalence between BEPS and existing energy standards.

First, we are concerned that a schedule which calls for reproposing BEPS by February 1981 and issuing final standards no later than August of 1981 will tend to make timing more important than content. This is unnecessary and would be extremely unfortunate.

We are in general agreement with the NIBS estimate of the time required to complete the development, testing and demonstration of BEPS.

We agree also with our colleague's comments here at the table relative to this issue.

The subcommittee should note most importantly that the proposed BEPS rule is not being created to fill a void. Existing building energy standards and codes, based on ASHRAE 90, are already in use in some 44 States.

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[1] See Appendix IX.

DOE's own research has indicated that these standards and codes bring about savings of 20 to 30 percent when properly implemented and enforced.

This moves a long way toward the goal set by BEPS.

Senator **Durkin**. Let me ask a question if I could here. You know, your accent does not indicate it, but the statement indicates you are from Texas.

Do you think the same building energy standards for Texas is the same standard we should have for New Hampshire or New Mexico or Arkansas or the State of Washington?

Dr. **Jones**. Senator, as I will indicate in a later portion of our statement, ASHRAE's plea is for the continued use of the consensus process in the development of energy standards. That was the way in which standard 90 was developed.

It provided for, allowed and solicited comments from all interested parties, including consumers and other groups, relative to the applicability, intent, purposes, methods, all aspects of the development.

Our interest is in preserving that consensus process for the very reason that you allude to.

Senator **Durkin**. Well, what have you got when you have a consensus besides a consensus? That is what bothers me. No offense, I mean.

Dr. **Jones**. In this particular instance, Senator, we have a standard which is workable which is being applied.

The General Accounting Office report was referred to earlier. It indicates that enforcement is not uniform across the 44 States which have adopted the standard.

It indicates that they would consider it somewhat reasonable in some 27.

The solution to that particular problem is to support the enforcement, development and, where necessary, the modifications to meet local conditions in these individual States.

The standard has been referred to in many different ways. It is basically a component performance standard. It looks at the envelope of the building. It provides climatic variations in the criteria associated with that to adjust for differing conditions and differing applications.

It addresses equipment. It addresses lighting. It addresses the electrical service systems within the building. It treats these in a way which a code official can understand and which a builder can understand and in which there is some hope for ultimate enforcement in the field, which is the real criteria of the effectiveness of any standard, that it be effective.

Senator **Durkin**. Everyone keeps talking about enforcement. You have to enforce it. If it is not obvious on its face, don't you have some problem?

Dr. **Jones**. Senator, in that regard, we are faced, in a competitive market, with a number of interesting phenomena.

The market, with economic forces in play, is moving us toward more energy efficient design.

The building owners are demanding more energy efficient design. Homeowners are becoming increasingly concerned in Texas, as well as in New Hampshire, with this particular aspect of things.

However, it is a very competitive market. There are lots of very small factors and very small margins.

In the situation of the ASHRAE standard, we have had comment and input from all segments of the industry. What they are doing is establishing a basic rule which they are willing to live by which gives them, in many ways, if you will, justification for doing what they need to do even in a competitive marketplace.

I hope I have expressed that correctly. The process is one of encouraging by setting a standard, by presenting goals which can be realized in a cost-effective way.

We believe that the continuation of the effort through the consensus process will achieve the objective, a very, very essential objective.

I have no quarrel with any of the comments that have been made today by any of the groups relative to the importance of conservation in buildings.

ASHRAE began its effort in 1974 to establish a workable tool for achieving energy conservation and new building design.

We are totally committed to that. Engineers are problem solvers. That is what we are attempting to do with our input and comment on the BEPS procedure.

We are trying to make a useful, constructive contribution to the process of formulating standards which, in the end, will be efficient and effective.

We are not interested in curtailing services. We are not interested in negatively impacting economic factors. We are interested in energy efficiency in building. That is what is going to accomplish the goals, provide the additional energy for other useful activities, production, for example.

We believe there are a number of substantive problems that remain to be solved before the proposed BEPS rule is brought into effect.

We support the concept of field testing of BEPS program, as proposed by DOE. However, we do not feel an adequate field testing program can be initiated, conducted and completed within the 1-year period indicated.

The proposed BEPS rule requires significant changes in existing building design and enforcement practice.

We feel that it is necessary that those who will be impacted by this be given an adequate time for educational and experiencial factors on a voluntary basis to bring them to the point where they can live with it and will live with it and, therefore, it will have some impact.

Implementing the proposed performance standard now would be premature.

Because achieving energy savings in buildings is an essential part, as I have noted, of the national energy program, we propose that Congress and DOE consider the following: support efforts to complete implementation and enforcement of existing building standards and codes.

This action would allow an early, timely completion of this process, and these energy standards, while allowing time for making needed improvements in BEPS, will save energy.

We don't have to wait to begin. We are not waiting to begin the process of conserving energy in building. It has been underway.

Second, we would propose to initiate a BEPS demonstration program with sufficient incentives to encourage widespread participation to provide an evaluation of effectiveness of the proposed rule, meaning for all building types and in all locations, not specifically confined, provide the incentives so that that will happen.

We would propose to support additional research to resolve the technical problems with BEPS, one of the primary of which is the standard evaluation technique that was referred to earlier.

Even in terms of those who know that program best, they will admit that it is not ready, able or capable of doing the job that is intended within the present BEPS rule. It must be improved.

We should improve interaction among DOE, affected State and local officials, design professionals, those who build buildings, those who supply materials and equipment for buildings, consumers, environmental interests for the continuing development of the BEPS program.

The fifth item: Develop a specific plan for disseminating information; the educational effort, in other words.

Professionals, code officials, contractors, and suppliers are not now, at the moment, equipped to handle the BEPS program.

We should be and we can be, given the proper time and educational efforts mounted in this way.

DOE stated in its proposal for revising the process of the rulemaking that the new rule will include a draft component performance standard similar to the conservation standard already developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, a standard that has been upgraded to be the equivalent of BEPS.

We would like to point out that this upgrade process has been underway for some time. It will continue. The standard is a living document. As technology allows, we advance, tighten the criteria and move forward.

Therefore, the present standard which has been recently completed saves more energy than that evaluated by the Department of Energy.

The future standard, the efforts toward which are beginning now, will save additional increments of energy in the future.

We welcome DOE's interest in providing this parallel path for compliance with the intent of the congressional mandate.

We applaud that effort, but we would urge you to suggest forcefully that DOE recognize the considerable advantage of utilizing the existing mechanisms for the development of equivalent consensus standards and participate in the updating of existing standards and codes based on ASHRAE 90 not only through our current efforts but through working with groups such as the National Council of States on Building Codes and Standards and updating the model code.

All of these efforts will contribute.

In closing, I wish to express ASHRAE's continuing support for constructive efforts to improve energy efficiency in new and existing buildings.

I assure the subcommittee that ASHRAE is anxious to work with DOE and others to develop and implement workable approaches to building energy performance standards. Thank you.

[The prepared statement of Dr. Jones follows:]

STATEMENT OF

THE

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

presented by

Dr. Jerold W. Jones

Chairman, ASHRAE BEPS Response Committee

Before the

Committee on Energy and Natural Resources

Subcommittee on Energy Regulation

UNITED STATES SENATE

June 26, 1980

Mr. Chairman and Members of the Committee:

Thank you for the opportunity to appear on behalf of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) in response to your review of DOE' proposed energy performance standards for new buildings, commonly called BEPS. Because ASHRAE has previously commented extensively on BEPS, this statement will be addressed solely to the proposed program changes outlined by the Department of Energy at your hearing on June 5, 1980.

I am Dr. Jerold W. Jones. I am Associate Professor of Mechanical Engineering and Director of the Energy Conservation Division in the Center for Energy Studies at The University of Texas in Austin. I have been Chairman of ASHRAE's BEPS Response Committee and was Co-Chairman of The Technical Advisory Group that reviewed the AIA Research Corporation's work on BEPS.

ASHRAE is a research-oriented, voluntary association of more than 40,000 members who have a professional concern with heating, cooling, ventilation, and refrigeration in buildings. It is a technical organization composed of consulting engineers, contractors, manufacturers, government officials, and educators who are involved with commercial and residential building design and construction, and it has been conducting research related to energy use in buildings for more than 50 years.

ASHRAE, founded in 1894, is recognized throughout the world as the leader in its field.

The members of ASHRAE are both knowledgeable and experienced in the development and implementation of energy standards for new and existing buildings. ASHRAE has previously testified on the history of the development of its Standard 90 "Energy Conservation in New Building Design" before the Senate Governmental Affairs Committee and the DOE hearing on it's Notice of Proposed Rule Making on Energy Performance Standards.* These statements outline the history of ASHRAE's development of Standard 90-75, the preparation of the code version of that Standard, the status of the first revision of the Standard, Standard 90A-1980, and our general concerns about BEPS. I offer copies of these statements for inclusion in the record of this hearing.

ASHRAE is gratified by the care and concern which DOE is considering the many, many comments submitted on the proposed BEPS rule.

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* Statement of ASHRAE Vice President Clinton W. Phillips to the U.S. Senate Committee on Governmental Affairs, November 20, 1979; oral and written statements of ASHRAE President Hugh D. McMillan, Jr. at the March 24, 1980, DOE hearing on the NOPR on energy performance standards for buildings.

We commend DOE for moving so forthrightly to revise its promulgation schedule and for recognizing the need to consider incorporating into a revised proposal many modifications suggested in the Public Hearings. We urge DOE to follow through with its stated plans. Although ASHRAE supports much of the revised BEPS plan presented by DOE before this Subcommittee, we do have several major concerns. They fall into two categories:

- The time requirement for completing the development and implementation of BEPS.
- The process of establishing the equivalence between BEPS and other standards.

TIME SCHEDULE

First, although DOE has proposed a revised target date for issuing a final BEPS Rule, we are concerned that a schedule which calls for reproposing BEPS by February 1, 1981, and issuing a final Standard no later than August, 1981, will tend to make timing more important than content. This would be unfortunate. We believe the work plan outlined by DOE is necessary. We also believe that it will probably take two or more years to complete. Rushing the BEPS might well mean wrecking the BEPS.

The Subcommittee should note that the proposed BEPS Rule is not being created to fill a void. Existing building energy standards and codes based on ASHRAE Standard 90 are already in use in some 44 states. DOE's own research has indicated that these standards and codes bring about savings of 20 to 30 percent when properly implemented and enforced. Taking the time required to resolve the difficult issues raised by the proposed BEPS rule does not therefore mean a delay in saving energy in new building design. Certainly the DOE plan should include goals and deadlines, but the overriding concern must be the effectiveness of the Standard -- does it do what it is intended to do and can it effectively conserve energy?

We believe there are a number of substantive problems which must be solved before the proposed BEPS Rule will be an effective and efficient standard. There are unresolved technical problems relating to the methods to be employed in demonstrating compliance, as well as administrative concerns relating to implementation. We believe the time requested by DOE is not sufficient to resolve these problems for the following reasons:

1. Field testing the BEPS program, as proposed by DOE, is extremely important, but in our opinion, an adequate field testing program cannot be initiated, conducted, and completed in one year. Attempts to accelerate such a program will inevitably lead to incomplete, inconclusive or contradictory results.

2. The proposed BEPS rule requires a significant change in the existing building design and enforcement process. Attempts to implement BEPS before those who must live with it have been adequately prepared to use it will generate a great deal of resistance and unnecessary confusion that will be counter-productive. An extensive educational effort will be required.

Implementing the proposed performance standard now would be premature. Because achieving energy savings in buildings is an essential part of the national energy program, we propose that Congress and DOE consider the following:

1. Support efforts to complete implementation and to enforce existing building energy standards and codes. This request is consistent with the directive of the Office of Management and Budget for Government agencies to use voluntary consensus standards wherever possible. Further, we urge Congress to direct DOE to make maximum use of existing standards, such as ASHRAE Standard 90, in the initial phase of implementing energy performance standards. This action would allow early and timely implementation of these energy standards while allowing time to make needed improvements in the proposed BEPS rule. ASHRAE stands ready to assist in such efforts.

2. Initiate a BEPS demonstration program with sufficient incentives to encourage widespread participation to provide an evaluation of the effectiveness of the proposed rule.
3. Support additional research to resolve the technical problems in the proposed Standard Evaluation Technique. ASHRAE is also ready to assist DOE in this endeavour. Its members are the professionals who have the knowledge and experience to evaluate the energy performance of buildings and of the systems and components of buildings.
4. Improve interaction among DOE, affected state and local officials, design professionals, those who build buildings, those who supply materials and equipment for buildings, consumers and environmental interests in the continuing development and implementation of BEPS.
5. Develop a specific plan for disseminating information to design professionals, code officials, contractors, suppliers and consumers on building energy standards.

EQUIVALENCY

DOE has stated that a reproposed BEPS rule will include "a draft component performance Standard similar to the conservation standards already developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) that has been upgraded to the equivalent of BEPS." While we welcome

DOE's recognition of the need for component standards based on ASHRAE Standard 90 as an integral part of building energy performance standards, we are extremely concerned that the existing consensus standards process may be bypassed.

We suggest that DOE recognize the considerable advantage of utilizing the existing mechanism for developing an equivalent consensus standard and participate in updating the existing standards and codes based on ASHRAE Standard 90. DOE has done this in the past. This approach facilitates broader participation in the review process than is available through normal DOE rule-making procedures.

In closing, I wish to express the ASHRAE continuing support of constructive efforts to improve energy efficiency in new and existing buildings. I believe that the government, technical organizations such as ourselves and other public groups can work together to achieve our common objectives. I assure the Subcommittee that ASHRAE is anxious to work with DOE to develop and implement a workable approach to building energy performance standards.

Thank you for this opportunity to comment.

Senator **Durkin**. Mr. Erlandson.

STATEMENT OF CHARLES W. ERLANDSON, CHAIRMAN, BEPS ADVISORY GROUP, AIR-CONDITIONING AND REFRIGERATION INSTITUTE

Mr. **Erlandson**. Good afternoon, Senator. My name is Charles W. Erlandson. I am testifying for the Air-Conditioning and Refrigeration Institute, ARI.

Since I understand that our prepared statement will become part of the record, I will read you a condensed version of it in the interest of time.

I am employed by the General Electric Co., Central Air-Conditioning Department, in Tyler, Tex.

My position with the company is manager of application engineering. The main points covered in my prepared statement are, No. 1, that we are much in favor of more efficient buildings and systems.

Two, we are concerned—very concerned with the complexity of the proposed BEPS standards.

Three, publication of the final standards should be delayed 2 years at least to allow time for additional study and field testing.

Four, a 2-year delay would cost little in unrealized potential energy conservation.

Builders and owners are building more efficient buildings voluntarily as a result of significantly higher fuel costs and concerns about availability of fuels.

Five, extensive field testing of the proposed standard and its implementation procedures must be done and a report on findings and conclusions should be made to Congress.

Six, weighting factors should be dropped. They serve only to increase the usage of our most scarce fuels.

ARI does not believe that DOE should dictate fuel choices.

Seven, electricity is not an energy source; it's an energy form which can be generated from coal, nuclear, hydro, geothermal, solar, and other energy sources.

Eight, utilizing electricity for cooling only will compound the existing problems of summer peaking and poor utilization of generating and distribution equipment by utilities.

Nine, a simpler, less costly standard evaluation technique must be developed (a) for residential and small commercial buildings and (b) as an alternate method for larger commercial buildings.

And my last item, No. 10, is not necessarily ARI's point. I would like to make it on my own. I am sure they would agree with me.

My personal suggestion for residential buildings is to develop a maximum overall U-factor for various geographic areas, as many as deemed necessary.

This would be a U-factor per square foot of envelope area.

This method would require only a simple calculation to determine compliance, would be equitable for both large and small homes, which is not true of the square foot area type of method, and would result in a true performance standard.

The builder would have many options in ceiling insulation and wall insulation, window quality, window area and many others in order to meet the requirement.

Envelope area, of course, is the gross wall area plus the ceiling area of a building.

That is the end of my testimony, and I thank you.

[The prepared statement of Mr. Erlandson follows:]

Statement of
CHARLES W. ERLANDSON
Air-Conditioning and Refrigeration Institute
to the
SUBCOMMITTEE ON ENERGY REGULATION
of the
COMMITTEE ON ENERGY AND NATURAL RESOURCES
of the
UNITED STATES SENATE
on
BUILDING ENERGY PERFORMANCE STANDARDS PROGRAM

My name is Charles W. Erlandson. I am submitting this statement to the Subcommittee on Energy Regulation on behalf of the Air-Conditioning and Refrigeration Institute (ARI). I serve at ARI as chairman of the Building Energy Performance Standards Advisory Group.

I am employed by the General Electric Company in its Tyler, Texas plant. My specific responsibility is Manager, Application Engineering, Central Air Conditioning, Business Department.

The Air-Conditioning and Refrigeration Institute is a national trade association composed of the manufacturers of more than 90 percent of U. S.-made equipment and related components and materials used in refrigerating systems and air conditioning systems. Room air conditioners are not within the ARI scope, however.

Because products manufactured by ARI member-companies provide heating and cooling in residential and commercial structures, standards which affect the thermal characteristics of buildings are of interest and concern to ARI. Regulations which either restrict or encourage the use of certain energy forms or equipment types will greatly affect the uses of ARI members' products.

INTRODUCTION

I shall keep my oral remarks brief. A more detailed analysis of ARI's position is contained in the attached written comments provided to DOE on April 30, 1980.

Building performance standards represent a new approach to building codes. Traditional codes include prescriptive standards - which, for example, might specify the size and thermal efficiency of doors or windows - or component performance standards - which might stipulate, for example, that a wall have a certain thermal efficiency, but leave it up to the builder to decide how to meet that requirement.

Performance standards for entire buildings are something quite different. They would tell the builder only that the completed building must consume no more energy each year than a specified number of British thermal units per square foot. The builder would have to decide how to meet that requirement.

The Energy Conservation Standards for New Buildings, October of 1976 (P.L. 94-385, Sec. 301, et seq.) mandated building performance standards out of a Congressional desire to avoid rigid rules that might hinder design flexibility and engineering innovation.

SUMMARY

ARI is in favor of the standards concept, whether those standards are in the public sector or the private sector, where such standards encourage the more efficient use of energy in the heating and cooling of buildings. There is no doubt that we should encourage innovations in the design of heating and cooling equipment which would make that equipment more efficient. If heating and cooling systems in buildings, or even the buildings themselves can be made more efficient, through innovation and design, we favor that. We believe, however, that some provisions of the proposed rule on BEPS which was published by the Department of Energy in November, 1979 will discourage rather than encourage such innovation.

ARI is also concerned about the complexity of the standards and the evaluation techniques which have grown out of DOE's attempt to develop a regulatory scheme pursuant to this law. We fear that this complexity will cause the costs and other burdens of a program to far exceed any energy-saving benefits to the nation. When we look at the cost of regulation at the local level, the cost to designers of analyses required only to assure compliance with BEPS, and similar cost considerations, we fear that innovation will be discouraged rather than encouraged. These are cost impacts which go far beyond the direct costs for additional building materials or more efficient building systems.

The BEPS as presently proposed are, in our opinion, untested, unsubstantiated and uneconomic. We urge that they not be implemented in their present form. We also believe that much more attention must be given to implementation of the standards.

For this reason, ARI believes that the date of publication of the final standards should be delayed by at least two years. (I might add that a two year delay would not result in a significant loss in energy potential. Builders and owners are voluntarily upgrading the thermal efficiency of new structures, primarily as a result of significantly higher fuel costs and concerns about availability.) We are aware that the Department of Energy has suggested a delay of one year, with a reproposal of the standard by February 1981 and an issuance of a final standard no later than August 1981. We do not believe that this period of time will allow the additional study and field testing of the standard which we believe should occur before it is implemented nationwide.

Furthermore, we believe that a considerable amount of field testing of this standard should occur to ensure its practicability. We are aware that the Department of Energy has proposed a program of field testing, including pilot programs in states which wish to participate. We believe that if this program is to be effective, it will require at least two years to carry out.

We also believe that when these tests have been concluded, a report to the Congress should spell out the findings and conclusions reached, including a thorough analysis of the impact of such standards on small builders, the cost of constructing such buildings together with the impact of such costs on the ability of low and medium income persons to purchase or rent such buildings, and a thorough analysis of the total energy savings to be realized from utilizing such standards.

Finally, ARI recommends that because the implementation of these standards needs such thorough study, the field testing process include the testing of implementation techniques. Adequate time is necessary for such testing.

WEIGHTING FACTORS

ARI is opposed to the inclusion of the weighting factors proposed in the November 1979 rule. Such weighting factors will, we believe, bring about increased use of oil and natural gas, and will increase demand, therefore, for imported petroleum and liquified natural gas.

We point out that such weighting factors also would have the effect of restricting the use of electricity as the energy form for heating buildings. The use of electric resistance heat under this rule would be almost prohibited, while the use of electricity to operate heat pumps would be severely restricted in many parts of the country. If electricity is not to be allowed as an energy form for heating, additional pressure on the nation's domestic oil supply will probably bring about the importation of additional oil. (Electricity is not an energy source, but rather an energy form which can be generated from coal, nuclear, geothermal, solar, hydro and other energy sources.)

As supplies of oil and natural gas go down, many existing structures must be converted to some form of heating by electricity. Such structures will be less energy efficient than would structures built to more stringent standards necessary to satisfy BEPS for electric heating.

ARI does not agree with the assumption in the BEPS proposal that electricity is to be the sole energy form used to cool all air conditioned buildings. As a matter of fact, the BEPS rule also requires the assumption that all buildings will be air conditioned. ARI disagrees. These assumptions are a direct consequence of the weighting factors in the proposed rule.

Another consequence of these weighting factors would be that new buildings which could be cooled electrically could not be heated electrically. In most parts of the country, summer peaks in electrical demand are the rule, and the weighting factors will increase these peaks without increasing winter demands for electricity. This would bring about inefficient use of electrical generating and distributing facilities in the winter. Such inefficiencies would be a burden on consumers.

ARI does not believe that DOE has been granted the authority by Congress to promulgate standards which have the effect of dictating the fuel or energy form which may be used to heat and cool buildings. The purpose of BEPS is to bring about the construction of more efficient buildings, not to establish a national fuel-management policy.

STANDARD EVALUATION TECHNIQUE

The Standard Evaluation Tecnique which is required under BEPS as proposed in November 1979 is so complex, so sophisticated, and so costly that it cannot be considered justified. ARI calls for a simpler method of evaluation to determine and assure compliance of residential and small commercial structures under a future BEPS plan.

ARI believes that a method such as that provided in ASHRAE Standard 90 (modified if necessary) should be provided as an equivalent alternative to the standard evaluation technique in the November proposal of BEPS. The procedure must be straightforward and readily understandable, a test which the ASHRAE Standard 90 procedure meets. If such a procedure were available, the implementation of the BEPS rule at the federal level would be simplified, and in addition the effective use of the standards at the local level would be made much more likely.

Furthermore, ARI calls for the issuance of simplified compliance codes and manuals before the proposed BEPS rules go into effect, so that they can be studied in conjunction with the proposed rule itself. In addition, the implementation rule must be known and understood before these documents can be assessed. We believe that there should be no further action taken on this rule until such simplified compliance procedures are available for review, analysis and comment.

In addition, we are opposed to the use of a single evaluation technique. Other computer programs and techniques normally used by design professionals who perform building energy analysis should be acceptable for use with BEPS.

IMPLEMENTATION

The initial BEPS and the implementation thereof must provide for sufficient leadtime to the manufacturing sector to ensure product availability. Before a particular budget level is set, it must be known that equipment, building system components, and building materials needed for compliance with the levels are or will be available in adequate supply at the time the standards become effective. Such availability must be assured.

CONCLUSION

ARI hopes that the information and comments presented in this statement are constructive and will be helpful to the Subcommittee. I will be glad to answer any questions which the Subcommittee may have.

WRITTEN STATEMENT
OF THE
AIR-CONDITIONING AND REFRIGERATION INSTITUTE
TO THE
U. S. DEPARTMENT OF ENERGY
OFFICE OF CONSERVATION AND SOLAR ENERGY
ON THE PROPOSED RULE
"ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS"
DOCKET NO. CAS-RM-79-112

The following comments on the proposed "Building Energy Performance Standards" (BEPS) (Docket No. CAS-RM-79-112) are submitted to the U. S. Department of Energy (DOE), Office of Conservation and Solar Energy, by the Air-Conditioning and Refrigeration Institute (ARI).

ARI is a trade association whose members are manufacturers of heating, air-conditioning, refrigerating, and energy-recovery equipment, and components and supplies which become a part of, or are used in, such equipment. Neither room air-conditioners nor household appliances are within the ARI scope, however.

Because products manufactured by ARI member-companies provide heating and cooling in residential and commercial structures, standards which affect the thermal characteristics of buildings are of interest and concern to ARI. Regulations which either restrict or encourage the use of certain energy forms or equipment types will greatly affect the uses of ARI-members' products.

ARI has identified several issues in the proposed rule which are of direct concern. Several of these were discussed briefly in the ARI oral testimony on March 24 (copy attached) in Washington, D.C.; these, along with several other issues of concern, will be discussed at somewhat greater length in this statement. The issues of concern to ARI are:

- Weighting Factors -- ARI opposes the use of weighting factors in establishing building energy performance standards for both residential and commercial structures.

- Need For Simpler Method As Equivalent Alternative To Standard Evaluation Technique For Residential And Small Commercial Structures -- ARI believes that there is a compelling need for a simpler method of determining and assuring compliance of residential and commercial structures with building energy performance standards and that this need must be satisfied before any final rule is issued.

- Standard Evaluation Technique -- ARI believes that, although computer analysis of the energy performance of large buildings is appropriate, the use of only a single evaluation technique should not be required. Other computer programs and techniques normally used by design professionals must be accepted for use with BEPS.

- Liability -- Differences between the BEPS "Design Energy Consumption" and actual energy consumption may create a potential legal liability on the part of the equipment manufacturers and others.

- Budget Levels -- ARI believes that the budget levels for commercial structures are unrealistically low in many localities, and that observing them will result in adverse indoor environmental conditions. Further, budget levels for residential structures and the analysis required to determine compliance, are unnecessarily complex and costly. For residential buildings, ARI suggests that a thermal efficiency index, based on the building shell, be used.

- Implementation -- ARI believes that the initial BEPS and the implementation rule must provide sufficient leadtime that the manufacturing sector can develop and have available products that permit compliance with BEPS.

Following the ARI oral testimony, the panel asked several questions. These issues will be discussed in Section VIII of this statement.

I. General Considerations

ARI supports the concept of standards, whether in the public or private sector, which encourage the more efficient use of energy in the heating and cooling of buildings. ARI believes that efficiency-inspired innovation in the design of heating and cooling equipment, in the systems which provide heating and cooling in buildings, and in the buildings themselves should be encouraged. We have a number of reservations and concerns, however, that certain provisions of the proposed rule will discourage rather than encourage such innovation.

ARI is also concerned that, as a result of attempting to develop a regulatory scheme which requires analysis of the performance of all non-process energy systems within a building, the standards and the evaluation techniques have become so complex that the costs and other burdens of the program will far exceed any energy-saving benefits to the nation. The cost impacts of the proposed rule will go far beyond the direct costs for additional building materials or more efficient building systems. These impacts include cost of regulation at the local level, such as the need for trained personnel who can understand and pass upon the submitted design to assure compliance with the BEPS. The costs to designers of analyses required only to assure compliance with BEPS must be considered when assessing impact. We are concerned that cost considerations such as these will discourage rather than encourage innovation to improve energy conservation in the design and use of buildings.

II. Weighting Factors

ARI believes that the weighting factors proposed will result in increased use of oil and natural gas, thereby increasing demand for imported petroleum and liquified natural gas. ARI would oppose the inclusion of weighting factors for this reason if no other, but ARI believes there are other sound, compelling reasons for opposing the use of weighting factors in the standards.

The weighting factors have the effect of restricting the use of electricity as the energy source for heating buildings. The restriction on the use of electric resistance heat would amount to near-prohibition; the use of electricity to operate heat pumps would be severely restricted in many parts of the country.

The exclusion of electricity as an energy source for heating has serious implications for the nation. The use of oil to heat structures located beyond the gas mains will be encouraged. This will place additional pressure on the nation's domestic oil supply and will encourage the importing of additional oil.

As supplies of oil and natural gas dwindle and become more expensive, it will become necessary to convert existing structures, including many designed under BEPS, to some form of heating by electricity. These structures, because they were originally built to standards that would satisfy BEPS for fuel-fired heating systems, will be less energy efficient than would structures built to substantially more stringent standards necessary to satisfy BEPS for electrical heating. Energy waste will result.

The BEPS proposal mandates the assumption that electricity is the energy form which will be used to cool all air-conditioned buildings. The BEPS analysis also requires the assumption that all buildings will be air conditioned. Neither assumption is valid, and both are a consequence of including weighting factors in the proposed rule.

Another consequence of the weighting factor in BEPS is that new buildings which could be cooled electrically could not be heated electrically. This will increase electrical demand in summer without increasing winter demands. Where summer peaks already exist, as they do in almost all parts of the country, the disparity between summer and winter demands for electricity will increase. Electrical generating and distributing facilities needed in summer will operate at inefficient, part-load capacity in winter. Inefficient facilities will be retained for summer use because construction of new, efficient generating capacity cannot be justified economically unless it can be used during more than one season of the year. Consumers will be further burdened as inefficiencies increase and energy costs soar.

ARI believes that the BEPS rule, when finally issued, should provide for the wise use of electricity for both heating and cooling buildings. It should recognize that most U. S. electricity is generated using renewable or non-depletable energy resources, as these terms are used in the BEPS proposal. According to information published by DOE, in 1979 less than 14 percent of U. S. electricity was generated in oil-burning plants. Furthermore, the Federal government is now actively encouraging the conversion of existing generating plants from burning oil to burning coal. Added electrical demand will increase oil demand only in proportion to the use of oil as a fuel for generating electricity, whereas encouraging the use of oil as a heating fuel will directly affect the demand for oil.

The only practical way to use energy resources such as coal, water power, and nuclear power to heat or cool homes and commercial buildings is to use those energy resources to generate electricity which, in turn, can be used to heat and cool the buildings. The most efficient way to heat and cool buildings electrically is to use the heat pump system, and ARI believes that the BEPS rule, when finally promulgated, should encourage its use.

If the BEPS, through the use of weighting factors or otherwise, discourage the use of electric heating, they increase the probability of electric utilities having to cope with increasingly serious summer peak-load situations. Already most utilities are summer peaking. If their facilities are to be used efficiently, these utilities must increase winter consumption of electricity in order to balance loads. If the use of electricity for heating is discouraged, the cost of electricity will increase and utilities will be unable to justify the replacement of old facilities with new, more efficient generating capacity.

ARI does not believe that building energy performance standards are the proper vehicle for the promotion of a particular type of heating or cooling system or the use of a particular fuel or energy source. ARI therefore repeats its opposition to the inclusion of weighting factors in any energy performance standards for new residential or commercial buildings.

The ARI opposition to including weighting factors applies to all types of buildings, for the general reasons stated above. There are additional reasons for the ARI opposition that apply to specific types of structures. A discussion of these follows.

A. Weighting Factors -- Single Family Residential

There are compelling reasons that energy performance standards for new, single-family residences should be concerned with the thermal characteristics of only the shell of the building. All of the general arguments against the use of weighting factors apply to residential structures, but they apply with greater emphasis.

Heating and cooling loads of residential structures are predominately weather-related. Although lights, appliances, and occupants within a residence do release heat, this heat release is a small proportion of the total heating and cooling load of the residence. Consequently, any residential energy conservation standards should deal almost exclusively with the thermal properties of the shell of the structure.

DOE should also be aware that the heating and cooling equipment used in residences will soon be required to comply with minimum efficiency standards issued by the Department. The standards rule, which is now being prepared, will be issued before any DOE building standards could become effective. Equipment which satisfies DOE minimum efficiency standards should be satisfactory for installation in new residential buildings constructed to comply with building efficiency standards.

The BEPS,as proposed,would result in a significant increase in the consumption of fuel oil for heating residences. Although some new housing is located so that natural gas can be supplied at acceptable costs, most new homes are constructed in subdivisions which are beyond the gas mains. Builders of these homes have only two practical fuel choices, oil or electricity.

Although oil is a fuel which can be burned efficiently and effectively for heating, any action which tends to encourage the use of oil for heating will increase the demand for oil. Such increased demand can be satisfied either by importing oil or by accelerating the consumption of domestic oil reserves. Neither action is in the public interest, and both actions are contrary to stated government policy. The BEPS must therefore not encourage the use of oil as a fuel for heating.

The other energy form which can be used for heating residences is electricity. Although ARI believes that the BEPS should be fuel-neutral, from a national policy standpoint the use of electricity to heat homes which are located beyond the reach of the gas mains is much more logical than is the use of oil.

An ARI analysis of the design energy consumption and design energy budget levels for a small home located in each of nine cities shows that in only one of the cities would a heat pump be acceptable when compared to heating with oil or natural gas. This analysis was based upon computer simulations of seasonal heating performance for heat pumps in cities ranging from Minneapolis in the north to Tampa in the south, and from Philadelphia in the east to Seattle and San Francisco in the west. Only in Tampa would the design energy budget for a heat pump system exceed the estimated design energy consumption.

The data given to ARI showed the energy consumed to heat the residence using electric resistance heating, and also using a heat pump including electric supplemental heat. The energy required to heat the house using a gas furnace was calculated from this data.

We assumed that an air conditioning system which might be used if the house were heated with gas would have the same characteristics as the heat pump operating on the cooling cycle. We then equated the cooling-season energy consumption for the heat-pump system to that of the gas-heating/electric-cooling system. Because the gas-heating energy consumption was known, the equation could be solved for the heat-pump design energy consumption which would comply with the electric-heat budget level. This was compared with the heat-pump system consumption of the original simulation.

Table 1 summarizes the analysis. Only in Tampa would the design energy consumption for the heat pump system -- 5,651 MBtu per season -- be less than the design energy consumption which the BEPS budget level for electric heating would permit -- 6,814 MBtu per season. Only in one city, therefore, would a home constructed to satisfy a gas budget also satisfy an electric heating budget when a heat pump system was used. In most cities, the difference was very great.

Table 1 Comparison of Design Energy Consumption with Heat Pump System and Maximum Consumption to Satisfy BEPS Budget

CITY	Heat Pump Seasonal Performance Factor	Design Energy, Consumption for Heating, MBtu/Season	
		Heat Pump (Actual)	Consumption which would Comply with Electric Heat Budget
Philadelphia	2.20	37,424	22,709
Chicago	1.93	53,662	32,125
Cleveland	2.00	50,672	31,163
Detroit	1.98	53,717	36,540
Louisville	2.15	35,864	21,555
Minneapolis	1.62	82,813	53,399
Tampa	2.50	5,651	6,814
Seattle	2.35	40,133	23,004
San Francisco	2.46	24,557	15,845

The elimination of budget levels would correct this problem, and would permit the use of electricity for heating when it could be shown to be efficient and economic.

B. Weighting Factors -- Commercial

ARI opposes the inclusion of weighting factors in the BEPS as they apply to commercial structures. The purpose of BEPS is to cause the construction of energy-efficient buildings; BEPS should not distort the selection of fuel, nor should they encourage the use of one fuel over another.

The proposed weighting factors appear to be based on unreliable forecasts of future costs. For example, it is stated that, at the time the proposal was prepared, oil was expected to cost 77¢ per gallon in 1985. The price was far above that before 1979 had ended. Because forecasts of future energy costs are likely to be unrealiable, the selection of fuel should be based on current real costs at the time the structure is designed and built.

ARI questions whether DOE has been granted the authority by Congress to promulgate standards which have the effect of dictating the fuel or energy source which may be used to heat and cool buildings under certain circumstances. Certainly the purpose of BEPS is to cause efficient buildings to be constructed; the function of BPES is not to establish a national fuel-management policy. Even if it were, the effect of the weighting factors is contrary to the stated national policy of reducing U. S. use of oil to reduce imports.

III. Need for Simpler Method as Equivalent Alternative to Standard Evaluation Technique for Residential and Small Commercial Structures

ARI believes that there is an absolute need for a simpler method of evaluation to determine and to assure compliance of residential and small commercial structures. The BEPS, as proposed, requires the use of an evaluation technique which is complex, sophisticated, and far too costly to be justified as an evaluation technique for residential and small commercial structures.

The procedure proposed would require each building design to be separately evaluated under each of several circumstances. In a housing tract, for example, a particular model of home can be repeated several times, but its design may be mirrored from one lot to another and the lots may face in any of several directions. Each variation would be required to be analyzed.

ARI suggests that a method such as that provided in ASHRAE Standard 90 (modified if necessary) must be avialable as an equivalent alternative to DOE 2, the Standard Evaluation Technique. The procedure must be straightforward and readily understandable, as the ASHRAE Standard 90 procedure is. This would not only simplify the implementation of the BEPS rule at the Federal level, but it would make much easier and more likely the effective use of the standards in each locality.

This simpler methodology must be in place and available for use as a part of a final BEPS rule when it is issued.

This need is recognized by the general accounting office. In his January 28, 1980, Report to the Congress, the Comptroller General concluded:

> "DOE needs to expedite its on-going activities to develop (1) methods of assessing the energy performance equivalency of building standards currently in use; (2) model building codes which will meet BEPS requirements; and (3) training programs for architects, builders and inspectors."

It is not enough to say that such codes or manuals should or will be available at the time the final BEPS rule is issued. These documents must be prepared and released so that they can be studied in conjunction with the analysis of the proposed rule. Furthermore, the implementation rule must be known and understood before these documents can be assessed. ARI urges that no further action with respect to this proposed rule be taken until the simplified compliance procedures are drafted and available for review, analysis and comment.

In making this recommendation, ARI recognizes that the nation's need to conserve energy is great, and that properly drafted building energy performance standards may play an essential role in energy conservation in the future. On the other hand, the need for simplified compliance codes and manuals is so great, and the present proposal is so complex that implementation of the proposed rule, either in its present or a similar form, will be counterproductive to the nation's energy conservation effort. Until such time as the BEPS proposal can be recast into a form more usable by all concerned, particularly the construction industry, the continued use of such standards as ASHRAE Standard 90 should be encouraged.

It must also be recognized by DOE that the existence of ASHRAE Standard 90 has already had great impact upon construction in this country. Since 1975, when Standard 90 was first issued, the thermal characteristics of new buildings have changed so that energy consumption per square foot of occupied space has declined. It continues to decline. The impact of BEPS on energy consumption in this country will not be nearly as great as it would have been if ASHRAE 90 had never been published, and any delay needed to correct deficiencies in the present BEPS proposal will not significantly affect the nation's energy situation.

IV. Standard Evaluation Technique

ARI favors the use of computer programs for evaluating the performance of complex buildings, but we believe that the use of a single evaluation technique should not be required. Other computer programs and techniques normally used by design professionals who perform building energy analysis must be acceptable for use with BEPS. Furthermore, there should be no requirement that results in one evaluation technique being used to design a structure and analyze its energy performance under intended conditions of occupancy, and another technique being used to assure compliance with a Federal standard. Both procedures should be accomplished using the same analysis.

ARI emphasizes that no program, no matter how sophisticated or complex, can give proper consideration to the thermal performance of all construction assemblies, mechanical systems or types of equipment. Unless the performance characteristics of a specific equipment type are well described within the program, the effect of that equipment on the design energy consumption of a particular structure cannot be adequately analyzed.

This raises two issues. The first is the difficulty of including data on highly variable part-load operating characteristics of all types of air-conditioning equipment used in large buildings in one program. The second is that new equipment designs, developed in response to the need for higher efficiency, cannot be immediately included within a program, such as that of the standard evaluation technique, because of administrative requirements which will have to be met to implement a change in the program.

Only by simplifying the evaluation technique can issues such as these be adequately addressed.

V. Liability

The BEPS proposal would require that a building's energy efficiency characteristics be evaluated at:

a) Specified operating conditions,

b) Specified weather conditions, and

c) Specified relationships among available energy sources.

Furthermore, the evaluation must be made using a specified technique and compared to criteria that do not consider actual occupancy, operating, or weather conditions. An evaluation of this type is not likely to give results that are comparable to actual building annual energy performance.

It is probable that building operators will not understand that a BEPS evaluation and a designer's estimate of actual building performance can be very different. The BEPS evaluation is not intended as an estimate of actual performance; nevertheless, misunderstanding will result and designers or others involved might be sued if actual energy consumption were substantially greater than suggested by a BEPS evaluation.

The designer or other individual being sued is likely to spend a lot of money and time to defend himself in such actions. Win or lose, he will have to bear a significant added cost, one which is brought on by BEPS. It must be considered when estimating the economic impact of the proposal.

IV. Budget Levels

A. General Considerations

The proposed budget levels for residential and commercial structures were developed, at least in part, to be used in conjunction with the weighting factors. Earlier in this statement, ARI advocated the elimination of weighting factors. We suggested that any analysis of building energy performance must be economically based on current real costs. Furthermore, such analytical procedures should be derived from data collected during the operation of existing buildings. This data base should consist of a larger, more comprehensive sample than was used in developing the weighting factors and budget levels contained in the BEPS proposal.

There are substantial inconsistencies in both the residential and commercial budget levels. It is likely that some of these are brought about by the inclusion of weighting factors in the proposal. If the weighting factors were eliminated, many of the inconsistencies could also be eliminated.

The reasons for differences in budget levels for cities close to each other are not apparent. For example, Dallas and Fort Worth are only a few miles apart. It is difficult to understand why the residential budget levels for Fort Worth are consistently below those for Dallas, whereas, for at least two commercial occupancies, the budget levels for the two cities are the same. Comparisons of budget levels for other pairs of cities, some located close together and some located far apart, raise similar questions.

The budget levels include energy required to both heat and cool buildings, but not all buildings are both heated and cooled. ARI suggests that requiring analysis assuming both heating and cooling can lead to greater energy consumption than might be the case if the energy analysis could consider only the type of system which would actually be installed. As will be discussed later, this issue may be of greater importance for residential than for commercial structures, but it has implications in both types of structures.

Uncomfortably high levels of humidity are frequently experienced in energy-efficient, low-load buildings. The sources of winter humidity are the occupants and moisture release from cooking, laundry, or other activities. Tighter construction and lower ventilation rates to conserve energy have reduced the introduction of drier, outdoor air and the removal of the humid air in winter.

In summer, latent loads and high humidities are caused by internal loads, just as they are in winter. In addition, humidity is brought into the structure by natural infiltration of humid outdoor air or by the ventilating system. In the interest of conserving energy, air conditioning systems are operated in summer at elevated aparatus dew-point temperature , resulting in little humidity removal by the system. Excessive humidity and an inability to control the humidity is a recognized summer-time problem in both residential and commercial structures.

High humidity problems have commonly been solved by means which may increase energy consumption. When winter humidity was caused by internal moisture release, added ventilation or more positive exhaust of humid air was the solution, and the building heating requirement was increased. In summer added ventilation,direct control of humidity using terminal reheat, and/or lowered thermostat settings were used; all result in greater energy consumption for cooling.

Federal regulations already mandate building operating conditions which make it difficult or impossible to control humidity properly in summer. When a space is to be held at not less than 78 F and coolant temperatures are to be not lower than 55 F, indoor humidity will rise to levels of discomfort. The occupant's reaction will be that the environment is stuffy or oppressive.

One possible cure to both winter and summer is to use dehumidifiers to relieve the humidity problem; however, dehumidifiers do require additional energy to operate. It is important that the existence of this problem be recognized.

B. Budget Levels -- Commercial

Particular attention should be paid to the building classification scheme proposed by DOE for commercial and multi-family residential structures. The fact that there are wide ranges of functions within each building classification does not appear to be recognized. In only a few classifications are the possible effects of building size and shape taken into account. For example, different budget levels are assigned for multi-family high-rise and multi-family low-rise structures. On the other hand, hotels and motels are considered as a single building classification, and all stores, be they small, isolated structures or large, multi-story buildings, are considered to be alike.

The type of system chosen to heat and/or cool a commercial structure has a major impact on the energy consumed to perform these functions. If a structure is to be both heated and cooled, then the system which can perform both functions most efficiently will be selected, and that system will be simulated in determining compliance with the budget levels. If, however, a building is to be only heated or only cooled, the normal design process would include the selection of only the system to do that job most efficiently. Forcing an assumption that all buildings will be both heated and cooled may result in selecting an inefficient heating system for a building which is not to be cooled because the BEPS requires that cooling performance be included in a theoretical analysis. This requirement is counterproductive in the energy conservation effort.

A great deal of study and field testing are needed to determine if the design energy budgets proposed for commercial and multi-family residential structures are reasonable, attainable, and will result in energy being conserved. An adequate data base to determine this has not been established, and the analysis presented is incomplete. ARI believes that the BEPS budget levels need to be reexamined, and that BEPS should not be promulgated until that work has been completed and subjected to scrutiny and review.

C. Budget Levels -- Residential

ARI suggests that budget levels, as proposed, not be used for single-family, residential structures. The use of budget levels is unnecessarily complex and will increase significantly the cost to design and build residential structures without increasing their energy efficiency.

ARI suggests that a concept, such as a "thermal efficiency index," be applied to assess compliance of residential structures with energy performance standards. This thermal efficiency index would be a climatically determined criterion for residential structures located in each climatic area. There should be separate indices for structures which are only to be heated, only to be cooled, and to be both heated and cooled. Each index number would reflect the severity and the length of the heating and/or cooling season in a defined locality. It should require that level of insulation and weather-proofing which is attainable, economically justified, and will conserve energy.

The index would express the maximum permitted design heat loss or design heat gain, expressed in Btu per hour per square foot of envelope or shell area. It would not reflect in any way the energy required to heat water for domestic use. The following procedures would be used to determine compliance of a proposed residential structure with the thermal efficiency index for the locality.

(a) The design heat loss would be calculated for residential structures which are to be heated or both heated and cooled;

(b) The design heat gain would be calculated for residential structures which are to be cooled or both heated and cooled;

(c) The design heat loss or heat gain would be compared to the appropriate thermal efficiency index as follows:

If heated only, compare heat loss with heating index;

If cooled only, compare heat gain with cooling index;

If heated and cooled*, compare heat loss with heating/cooling index.

*Alternatively, the heat loss and heat gain could be separately compared to the heating and cooling indices.

If the design heat loss or gain, as the case might be, were equal to or less than the appropriate thermal efficiency index, the structure would comply with the BEPS criteria.

Whatever index levels are prescribed should be cost effective and based upon reasonable assumptions that can be supported by research investigations. They should not be based upon subjective forecasts of what might happen in the future.

ARI suggests that DOE consider establishing levels of thermal efficiency indices in not more than two stages. The first should become effective no earlier than one year following promulgation of the final rule. Compliance must be achievable using building components, subsystems and equipment that are commercially available now.

Another stage of thermal efficiency indices requiring higher energy efficiencies would become effective at some later date. Both sets of levels should be prescribed at the same time. The time between the effective dates for the initial and the final levels must be sufficient to permit manufacturers of heating and cooling equipment and other building components, and the suppliers of building materials to anticipate the effects of higher performance requirements, so that complying products can be available when the higher levels go into effect.

VII. Implementation

The initial building energy performance standards and the implementation thereof must provide for sufficient leadtime to the manufacturing sector to insure product availability. Before a particular budget level is set, it must be known that equipment, building system components, and building materials needed for compliance with the levels are or will be available in adequate supply at the time the standards become effective. Such availability cannot be assumed; it must be assured.

The availability of equipment which is compatible with the systems in low-load buildings must be investigated. The BEPS proposal asserts that such equipment is available, but specific examples of unavailability have been noted by other parties. The air-conditioning industry is no exception to this, for, until the impact of the BEPS on indoor humidity can be assessed, equipment which can comply with the efficiency requirements and at the same time remove the sensible and latent loads cannot be developed.

VIII. Issues Raised at March 24 Hearing

At the public hearing held in Washington, D.C. on March 24th, the ARI witness, Mr. H. T. Gilkey, was asked several questions, in paraphrased form, and the ARI responses follow.

A. Life Cycle Cost Analysis

ARI was asked if it supports the concept of life-cycle cost analysis for new buildings.

ARI does support the concept of life cycle cost analysis for larger, more complex buildings for which computer simulation of building operation is economical. As stated elsewhere, ARI believes that the techniques and programs commonly available and used by design professionals, must be acceptable for use with the BEPS.

B. Equipment and System Life

ARI was asked what the life expectancy of air-conditioning systems and equipment might be, and what life period should be used in a life-cycle cost analysis.

The industry experience has been that the life of residential equipment is from 10 to 15 years under most circumstances and that commercial equipment is likely to remain in service for at least 20 years. The industry does not know if the newer, more efficient equipment, which utilizes energy more intensively, will have this same service life when operating under conditions mandated by energy conservation considerations, including energy performance standards for buildings.

ARI believes that the life term in a life-cycle cost analysis should be somewhat less that the life expectancy of the equipment. We believe that, if equipment installed today in a commercial structure can be amortized in between 10 and 15 years, the owner of that structure will be encouraged to replace the old system with a new one which will provide greater energy conservation opportunities. In the case of residential systems, we suggest that the life period in the life-cycle cost analysis, if one is run, should be the estimated average occupancy of the first two owners.

C. Information on Product Efficiency

ARI was asked if it could provide information to DOE on product-efficiency trends of both residential and commercial air conditioning equipment during the past two years and projections into the future.

Because DOE now requires that manufacturers express the energy efficiency of residential air conditioners in terms of a seasonal energy efficiency ratio (SEER), it is impossible to compare the efficiency of new products with those produced in the past when efficiency was expressed as an energy efficiency ratio (EER). The two terms cannot presently be compared directly.

The efficiency of the most efficient models of residential air conditioners now on the market appears to reflect very nearly the limits of current state-of-the-art technology. Efficiency improvement of the most efficient models is therefore likely to be small during the forseeable future. Efficiency improvement of the average of all models available will increase as less efficient models are phased out during the years ahead. This will be caused partly by the minimum efficiency standards promulgated by DOE.

Information on part load and operating efficiencies of commercial products are contained in the data of the individual equipment manufacturers. ARI cannot estimate how much information is available nor can it assess the validity of that information. However, equipment manufacturers are emphasizing the energy conservation opportunities which are available to building designers through the use of newer, more efficient equipment and the optional features available with this equipment. Equipment efficiency has become an important element of competition in this industry.

Conclusion

The ARI concerns are summarized at the beginning of this statement. ARI hopes that the discussion of these concerns and the suggestions for improving BEPS will be helpful to DOE.

Senator **Durkin**. I want to thank the panel very, very much.

Mr. **Riddick**. Could I make one comment? ASHRAE 90-75 is about this voluminous [indicating].

The present BEPS with the supporting documents is much larger, like this [indicating].

My company, which is an engineering company involved in energy conservation—it takes great analysis to work out any one point of BEPS by qualified engineers with lots of experience.

And to practically impose this stack of regulations on the country, the way it is now—it has to be simplified. I am supporting the statement that he said that it was too complicated.

Senator **Durkin**. Thank you, gentlemen.

The next panel is Carl Bagge and Joan Shorey.

STATEMENT OF JOAN SHOREY, SOLAR LOBBY

Ms. **Shorey**. I will not read my statement. I will just talk to you very quickly and briefly so we can get forward.

I am here representing Solar Lobby, and we have been doing a lot of work and are concerned about BEPS.

Particularly, we are interested in the relationship of solar energy and BEPS.

And solar energy, as you well know, particularly passive, relates to the design criteria of the building. And this is something that can be very, very important and fulfill the mandates of the regulations to move forward renewable energy in BEPS.

Therefore, we are supportive of BEPS and we are supportive of getting BEPS moved forward and getting it out into the field and see how it works and see how it can be revised.

We do feel that there can be improvements and have testified to that, as far as solar energy can be integrated into the BEPS.

But I want to say here that I think there has been an awful lot of criticism of the Department of Energy. And, surely, you are aware that Solar Lobby has, in other instances, taken strong positions in terms of DOE's expertise.

But I want to say here that I think that there is a lot of evidence that problems are getting solved and that they are moving and that the right questions have been asked.

And I want to talk about this for just a minute in terms of solar.

One is that, in the initial regulations, they said that there was not enough information out in the field about solar and the builders were not onto it so that it really wasn't a going concern and, therefore, it couldn't be programed into the initial regulations.

But I think that is changing now. There have been articles in Newsweek and Business Week lately talking about builders using solar.

I have some plans that have been developed by the Northeast Solar Energy Association where they have taken BEPS design and have taken them into the computer program and tried to figure out how they will fit the BEPS, come out with 50 percent savings using solar, payback within 5 years.

I mean, this is all moving, and it is right there, ready to go, now, to get into the BEPS process.

I think that the expertise is developing within the Department of Energy. I think that you all have a responsibility to see that more people get pulled into the BEPS process in the Department of Energy. They surely need that.

But it is beginning to go. It is all beginning to mesh together. And I think that we have to be very careful here that we are not getting a lot of negative comment on this process.

And I will say that I think there is a certain built-in negativism from the people that have been behind the ASHRAE and have been the engineers. I can understand that.

The point of BEPS is to get moving new processes, to get into the building world a new way of looking at energy components.

And I think that this is something that I do not want to see deterred by Congress.

And I hope that you will, indeed, keep an open ear to developments that are coming forward.

Now, that really—at this point, I think that that is all I have to say.

I hope you will look at my testimony. I hope that you will review the testimony that was presented by the Wildlife Federation and the Conservation Foundation.

I would like to submit with my testimony a really good outline of BEPS that the Conservation Foundation has done for members of Congress.

I think that they have not been very well informed about BEPS.

I have one other point, and that is that the regulations of BEPS are not 12 inches high. Those are the supporting documents that go behind the BEPS.

And I think that there is a slight misconception about the intricacies and complications of the BEPS process, as it has come forward. Thank you.

Senator DURKIN. Thank you.

[The prepared statement of Ms. Shorey and the memorandum from the Conservation Foundation follow:]

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June 26, 1980

Testimony of Joan Shorey for Solar Lobby
on the Building Energy Performance Standards (BEPS)
Before the
Senate Subcommittee on Energy Regulations
The Committee on Energy and Natural Resources

Thank you for the opportunity to appear here today. I realize you have a full roster so I will be brief. Our organization concurs with the comprehensive testimony presented at your last hearing by the Wildlife Federation and the Conservation Foundation. We are all convinced of the importance of the Building Energy Performance Standards. And even though I believe that the proposed regulations could be improved, I think the shortcomings can be alleviated fairly quickly in ways I will spell out in a minute. The Solar Lobby's overriding concern is that standards are promulgated now so government can see how they work and then revise them accordingly. Although the Senate passed an amendment granting a two-year extension for the implementation of the regulations, we urge you to prod the DOE to act as expeditiously and swiftly as possible within this framework.

As the Solar Lobby's representative, I want to talk just briefly about BEPS and solar energy. After all, the performance of solar energy depends on the design of the building. The BEPS are performance standards that rely on designs suited to particular energy-budget levels. In short, performance standards and the use of solar energy fit each other like gloves. And, actually, the snugger the standards, the more suitable solar becomes to bring building designs into the BEPS energy budgets...economically and technically. On top of that, it is just plain good sense to design a building to include the most cost-effective conservation and solar applications.

My fear is that good sense has not continually prevailed in the development of BEPS. A few issues in particular need to be re-examined if the fit of the glove is to be a little tighter in the near future.

First, the enabling legislation for BEPS requires that the standards encourage the use of renewable energy. As you know, solar is a renewable energy source that comes in two flavors--passive and active. However, the BEPS as they have come forward in this current proposed rule only principally encourages the use of active systems, mainly those for producing hot water. One reason passive applications have been slighted is DOE's inability to combine the solar and conservation expertise within its staff projects. During the formation of BEPS, the passive expertise was not as highly developed as it is now and the conservation division that was running the BEPS show did not muster all the solar wisdom there was. In addition, the assumption underlying the research on the energy budget levels is that only "conventionally accepted" building techniques can be employed for those prototype houses used to develop the budget levels. So, as stated in the Department document, DOE failed to consider "different approaches to passive solar energy design strategies" because these techniques appeared too removed from current building practices. On its face, this is a "Catch 22" position. But because it was adopted anyway, one of the most significant contributions of nondepletable energy was not factored into the proposed standards. Also, compounding the ineptness of this void was DOE's analysis of the cost-effectiveness of solar where the BEPS analytical studies found passive solar to be economically competitive in 9 out of 10 representative cities.

The Solar Lobby believes that the artificial distinction between solar and conservation strategies can be dismantled. We also believe performance standards such as those that can now come out of the DOE hopper will catalyze the building industry, stimulating in a productive and relatively painless way the use of solar energy in both new and existing buildings. We also entertain hope that DOE will be able to straighten out the current rule in terms of solar energy and we are dead certain that there is enough evidence, and expertise to bring forward a BEPS we and the building industry can support.

First, the evidence is all about us that builders are, to use the current phrase, "into" solar energy. Both Newsweek in

April and Business Week this June featured articles on solar buildings and their favorable economics. The National Association of Home Builders (NAHB) reported this September on the "how to" of active and passive systems under the HUD demonstration program. And, finally, under the direction of the North East Solar Energy Association, five typical standard house designs were tested to fit the proposed BEPS Budget levels using no special hardware, only sound conservation measures and solar designs. These plans came forward with projected costs that would be paid back in five years and reduce energy consumption by 50 percent. Surely, it is unfair to call such solar applications beyond the fringe.

Second, the expertise needed to integrate solar considerations into BEPS does exist. The NAHB put up flags of alarm about the inabilities of the initial DOE computer program used in the beginning of BEPS' long birth. However, the technical BEPS documents now available state that several computer programs are being groomed for BEPS. Also a SERI publication released this January describes at least 17 different analytical tools for use in evaluating solar heating and cooling. And last week I received a Passive Design Handbook prepared by the Los Alamos Scientific Laboratory to provide "quantitative tools which will enable the designer to size solar glazing, thermal storage and other elements of a building in order to achieve a comfortable building and a satisfactory solar heating performance."

So here we are with appropriate designs developed and used by the building community and with a growing body of techniques and information for evaluating the "how to" of solar design. Furthermore, DOE is already preparing manuals of recommended practices and prototype designs to help builders and designers comply with BEPS. Now is the time to make sure conservation and solar techniques are insisted upon in these manuals and to set in motion the surveillance needed to make sure such integration does happen. Again, let me say that the signals and the cadre now exist for such a strengthened BEPS, that the process need not be difficult or lengthy, and that Congress must be sure that such BEPS come forward as soon as possible. A two-year moratorium on this common-sense approach makes no sense at all.

The Conservation Foundation

MEMORANDUM

TO: Persons Concerned About Building Energy Performance Standards (BEPS)

FROM: Grant P. Thompson, Senior Associate, The Conservation Foundation

SUBJECT: Questions About BEPS -- What They Are and How They Will Work

Viewed from the outside, the proposed BEPS appear complicated, hard to enforce, and costly to implement. These are misconceptions. Based on the work I have been doing over the past seven years on regulation of energy use in American buildings, I thought answers to the following questions might be helpful in sharpening and clarifying the discussion.

Q. What are BEPS for and how will they work?

A. Dollar budgets are a fact of life for any builder; BEPS simply adds an energy budget that has to be met as well before a new building is constructed. Instead of being expressed in dollars, the BEPS budget puts a limit on how much energy per square foot a building can use over the course of a year. Setting the budget level is simply a matter of balancing additional first costs against the future cost savings for energy that won't be needed to heat and cool the building.

BEPS are a decided advance over existing energy conservation standards, such as ASHRAE Standard 90-75. Instead of telling the builder what must be done to comply, BEPS gives a free choice to builders to pick any way they choose to build an energy efficient building. Innovation and money saving are encouraged by a performance standard like BEPS.

Q. Isn't the amount of energy that BEPS promises to save rather disappointing?

A. Actually, the amount of energy that can be saved by a good building standard is breathtaking. Buildings use about 37% of our energy. Simple changes, using existing technology, can reduce that use dramatically. DOE calculates that the Standards will have the following effects: "single-family residential buildings designed to comply with the proposed Standards might use between 22% and 51% less energy than current practice, and commercial and multifamily residential buildings might use between 17% and 52% less energy." Yet as experience with the Standards grows, as new more efficient heating and cooling equipment becomes available, and as energy prices rise, many builders predict homes that will use 75% to 90% less energy than current practice. And making changes in the building stock of this country is like starting an avalanche: a very small change during the first period grows and grows until the cumulative effect is more important than the small beginning would ever have suggested. But for every year we delay in starting, the savings are even further postponed.

Q. Haven't BEPS turned what ought to have been a simple program to upgrade new buildings into a nightmare of complexity and technicalities?

A. This is a common misconception about BEPS. The research work that supports the BEPS program simply demonstrates what professionals in the field have known all along: buildings are more complicated than they appear to the layman.

But the complexity of the research work does not mean that BEPS will be complicated to use in practice. A laboratory aide or a paramedic can easily inject a vaccine he could neither develop nor manufacture; a high school student can use a pocket calculator without understanding how to make a transistor. In exactly the same way, no builder, building code inspector or architect will have to understand -- or even know about the existence of -- the rigorous technical basis of the Standard.

Q. Hasn't DOE made the Standards so harsh that no builder will be able to build homes that ordinary people can hope to afford?

A. No, in fact at every point there was a choice to be made, DOE leaned toward making the Standards lenient. It used assumptions about future fuel costs that OPEC's ministers have already made obsolete; it assumed no improvements in technology; it discounted the enormous contribution that passive solar heating can make to buildings. In fact, DOE's own calculations show that stronger Standards would save consumers and the Nation more energy and money. Lenient Standards might be justified in order to give the building industry time to gain experience with a performance standard, but Congress should insist that DOE develop a timetable to strengthen them soon.

Q. Even if users don't have to understand the inner workings of BEPS, won't they at least have to be faced with pages of forms to fill out to be fed into some expensive computer?

A. No, most builders and building code inspectors will see very little difference in their normal working practices after BEPS are in place. The Department of Energy is right now in the process of developing aides that will be used by the vast majority of builders. These aides include:

- Revised versions of the codes most frequently used now by builders and code officials to guarantee that homes and small buildings built to satisfy those codes will also satisfy BEPS.
- Standard designs, that can be sold by companies that today sell standard designs to thousands of small builders. Since BEPS apply not to individual buildings, but only to designs, a standard design (individualized of course to particular climate zones) can be as cheap to purchase after BEPS as it is now.
- Computer programs that can be used to analyze more complicated buildings, so that large design firms, architects, or others who want to be experimental will not be limited to any cookie cutter, "government-issue" design.

Thus, the situation will be as easy for most builders as it is now, but unlike existing building energy codes that are inherently rigid, the innovator will find ways to do better than BEPS any way his ingenuity suggests.

Q. But can we trust the computer work that DOE has done? Some people have said it leads to crazy results.

A. Some critics of BEPS have tested an early version of a BEPS computer program in various cities. Their results seemed to suggest bizzare design results. Yet that work was flawed both by input errors and by use of an earlier, less sophisticated computer program than DOE now uses. To be sure, improvements will and should continue. But the underlying bias of the Standards, as I discussed above, is conservative. Outlandish results are unlikely to occur in practice and will be eliminated after early experience.

Q. In the existing depressed state of the housing market, is it fair to add another cost on builders and buyers alike? Can't this wait?

A. Many people have been worried by the fact that extra conservation at the first may drive many homebuyers out of the market. Yet little corresponding sympathy seems directed towards buyers who later can't meet their monthly mortgage payments because their heating and cooling costs soar. Thus, the question of costs needs to be kept in perspective.

DOE's highest estimates of the additional first-costs for homes suggest that it might add $1,500 to the price of a new home to comply with BEPS. This is about the cost of a fancy refrigerator/freezer, and about one-fifth the cost of a new car. Unlike the appliance or the car, however, the conservation features begin producing savings, not adding costs.

And DOE's estimations may even be too high. In work produced for the Department of Housing and Urban Development in the early stages of BEPS, HUD discovered that simply by educating designers about energy conservation, almost all of them could produce better buildings at lower first costs! Thus, with BEPS as a floor and education and market forces as an incentive, it is possible that actual first costs might drop, not rise as some fear. In any case, with BEPS total costs to consumers and the Nation will surely drop.

Q. One of the confusing things about BEPS is the "weighting factors." What are they and why do they belong in an energy conservation regulation?

A. Weighting factors are necesary to assure that new buildings use all types of energy efficiently. The weighting factors help the designer understand that electricity uses more natural resources than oil or natural gas and thus will ultimately cost the consumer more to use. Therefore, BEPS encourages the builder to use electricity efficiently: either by compensating for its higher cost by more careful design and insulation or by using existing, more efficient technologies (like the heat pump) to convert electricity into heat. Without weighting factors, BEPS would not be neutral: instead, they would be badly skewed in favor of a heating source that is cheap to install but expensive to use.

Q. What about sanctions? Are they needed? What should they be?

A. Unfortunately, energy conservation features are hard for a consumer to detect or test when he or she is buying a home or an office. If the buyer then finds the building design does not comply with BEPS, making the necessary improvements later is expensive and disruptive. Therefore, there needs to be some guarantee that every consumer gets at least a minimum standard of conservation performance. Sanctions will simply guarantee that the consumer won't have to rip open his or her new home later to do what could so easily have been done right (cheaply) at first.

To be sure, the sanctions provided in the original Act are too harsh and unselective. When the Standards are finally promulgated, the Department of Energy should suggest a more flexible basket of incentives and sanctions. But DOE has already promised to do that. Congress should allow DOE the flexibility necessary to help those States that want and need assistance and to prod those who drag their feet.

Senator **Durkin**. Let me ask just one question. I think you probably saw the GAO study of the DOE's implementation of the solar program which, in a sentence, said it was a symphony of chaos.

What makes you think that they would do any better a job?

Ms. **Shorey**. Well, because I think that we have spoken out and you have spoken out, GAO has spoken out, OTA has spoken out.

And I think that there is quite a lot of evidence that has come forward and come into the consciousness of the top officials of the Department of Energy to get this straightened out.

One of the problems has been that there has been a lack of integration of the conservation and the solar divisions in the development of BEPS.

There is a perfectly valid example of what has happened. And I think this is getting straightened out.

And that is the point that I am trying to make. I think the criticism has been heard, and I think there are movements now in the direction to get that straightened out.

I certainly feel that it should be because I think solar has gotten the short end of the stick.

But I think that your pounding the table and our pounding the table and those other reports are moving in that direction.

I think they need more staff. And, as I say, I think the fact that other staff is being brought into it, from a solar point of view, is going to be extremely useful and important.

Senator **Durkin**. I'm not sure, when the fever drops from 105 to 104, you discharge the patient though. I am not sure that——

Ms. **Shorey**. Well, now, my point is that I think we are in a more recuperative stage than that. I think we have come out of the hospital and I think we are coming out now and we are coming back to work.

And I think that if we give it a little bit of time, that's what we need. Then, I think we ought to really get back and get it moving.

So, I hope that you will push to get the standards out. I am afraid that if we get this enormous pressure for delay, that it is going to keep the patient in the hospital even longer. You aren't even going to worry about it. You know how that works.

Senator **Durkin**. Oh, yes. I have been up that street before. And I think you know my commitment to solar.

Ms. **Shorey**. I do, indeed.

Senator **Durkin**. But I do share some reservations about DOE and their performance. And you mentioned the North East Solar Energy Association. I haven't seen them produce much yet other than an organizational chart which looks like the organizational chart of the Holy Roman Empire.

Ms. **Shorey**. Well, again, I think we have got to keep pounding the table, but I think that they are moving. And I think that it is the result of what you and I are doing right here.

I think that is very important. Again, the structure is there. And I think we have got to see that that happens. And I think it can.

Senator **Durkin**. Thank you.

Carl?

STATEMENT OF CARL E. BAGGE, PRESIDENT, NATIONAL COAL ASSOCIATION

Mr. **Bagge**. Mr. Chairman, first of all, I would like to say that the coal industry is honored to be called here in the presence of the Solar Lobby on this issue.

Ms. **Shorey**. Oh, indeed. The last time I saw Carl Bagge, he sang. Now, he may do it today.

Mr. **Bagge**. We—our concern, Mr. Chairman, is that BEPS, as now proposed by DOE, would discriminate—it's a very simple concern—it discriminates against the use of electricity in favor of the increased use of natural gas and oil.

Over 50 percent of our Nation's electricity is now being generated by coal, and that share is expected to grow as new coal-fired powerplants are constructed.

Increased use of electricity has reduced and will continue to reduce the need to import oil and use up nonrenewable domestic resources that are in short supply, such as natural gas.

We submit that these regulations bias energy choices in favor of increased use of oil and natural gas and are not in the public interest. The previous witness referred to that as well.

In addition, we believe that there are five other serious problems with the BEPS from the standpoint of national and public interest.

Briefly, first, BEPS are contrary to our national policy of conserving nonrenewable domestic resources for their highest use. And we deal with that extensively in the formal statement.

Second, BEPS would maximize economic risk to energy consumers.

Third, BEPS would encourage construction of less efficient buildings.

Fourth, BEPS would unnecessarily impose excessive administrative and regulatory complexity upon the construction industry. And that has been referred to and documented earlier.

And, finally, the States would not be able to implement BEPS as intended by the Congress.

And we are prepared to elaborate on these points, if you wish. They are all addressed in our statement in chief.

In conclusion, for all these reasons, DOE should defer further rulemaking. And we support—and I want to say on the record that we support your bill S. 2862 which does precisely that.

The concept of weighting factors, which factors have led to the biases I have described, should be abandoned completely when the final rules are developed.

This action would properly focus BEPS on the amount of energy consumed at the building site, which we think was the intent of Congress, eliminate improper disincentives for the use of more abundant domestic fuel such as coal, provide greater incentives for the construction of the most energy-efficient new buildings and, finally, more closely approximate the regulatory approaches now in use at the State and local level, which is working.

And all these good things that my friend with the Solar Lobby said is occurring already without BEPS.

Senator **Durkin**. I have one question to both of you. I mean, if you believe the polls, there seems to be an excellent chance that there will be some new people sitting in the top chairs at DOE come January.

And what if they have—turn out to have a total—I mean, God forbid, Jim Schlesinger is like a Ray-O-Vac battery. And what happens if Jim ends up back as Secretary of Energy? [Laughter.]

Senator **DURKIN**. And we have, you know, a total radioactive bias in every decision made by DOE?

Ms. **SHOREY**. Well, then, let's get cracking. Let's get them out now and get it going. [Laughter.]

Senator **DURKIN**. I asked for that one.

Mr. **BAGGE**. I wouldn't touch that question with a 10-foot pole, Mr. Chairman.

Senator **DURKIN**. I'm beginning to believe I shouldn't have either. [Laughter.]

Senator **DURKIN**. I think I will quit on that one.

Mr. **BAGGE**. I would just like to formally submit for the record the statement in chief. And I would also, if I could, submit for the record the extensive comments of the Coal Association in docket CAS-RM-79-112, which was addressed to Joanne Bacos of the Office of Conservation and Solar Energy, which are our comments on the proposed regulations which I think should be relevant and should be of interest to the Congress.[1]

Ms. **SHOREY**. Now, I don't want to be left out at all, so I would like to submit for the record the testimony of Solar Lobby and the Center for Renewable Resources on the Regulations.[2]

Senator **DURKIN**. Fine.

[The prepared statement of Mr. Bagge follows:]

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[1] See appendix X.
[2] See appendix XI.

NATIONAL COAL ASSOCIATION

STATEMENT BY

CARL E. BAGGE
PRESIDENT
NATIONAL COAL ASSOCIATION

on

Proposed Rulemaking
of the
Department of Energy
"Energy Performance Standards for New Buildings"

before the

SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
SUBCOMMITTEE ON ENERGY REGULATION

June 26, 1980

OUTLINE AND SUMMARY

Introduction. 1

NCA supports national objectives of improving energy efficiency, reducing dependence on insecure foreign energy sources and relying instead on domestic resources. BEPS, as proposed, would work contrary to these objectives.

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A. BEPS Would Bias Future Fuel Choices Against Electricity, Largely Generated From Domestic Energy Resources, And Towards The Use Of Oil And Natural Gas Already Being Imported In Significant Quantities. 5

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ATTACHMENT: "Trends in the Price of Oil, Coal and Natural Gas Delivered to Utilities," April 1979.

Mr. Chairman, my name is Carl Bagge. I am President of the National Coal Association, which represents firms producing most of the nation's coal, and other organizations concerned with coal production, transportation, and use. I want to thank the Subcommittee for the opportunity to express our concerns about the Department of Energy's proposed rulemaking entitled "Energy Performance Standards for New Buildings." These standards are now universally referred to as "BEPS," and I will use that term to refer to the proposed rulemaking throughout my statement.

At the outset, I want to emphasize that NCA supports the current national policies of improving energy efficiency, reducing dependence on insecure foreign sources of energy, and increasing our reliance upon abundant domestic energy resources.

We believe that BEPS would produce effects directly contrary to these objectives. We strongly oppose their promulgation in their present form, and urge this Subcommittee to exercise continuing oversight responsibilities directed towards BEPS.

We especially hope that the focus of this Committee's attention will not merely be upon pending legislation to extend the time period for DOE to promulgate final rulemaking. We hope the Committee will address the substance of BEPS, and send to its draftmen a clear statement of Congressional disagreement with the policy choices made to date.

Summary of Concerns

Briefly, we have five principal concerns.

First, we believe BEPS is contrary to our national goal of reducing reliance upon foreign sources of energy. The use of "weighting factors" in BEPS will create overwhelming economic incentives to the use of oil or natural gas for space heating and cooling (space conditioning) in new construction, and proportionate disincentives to the use of electricity. More than 70 percent of the nation's electricity is currently being generated from exclusively domestic energy sources (coal, nuclear, hydro, etc.). BEPS thus creates support for current unacceptably high levels of oil and gas imports.

Second, we believe BEPS would be contrary to our national policy of conserving scarce nonrenewable domestic energy resources for their highest uses. The highest use of oil and natural gas is clearly as feedstocks or in industrial processes.

Third, we believe that the intent of the Congress in enacting the Energy Conservation and Production Act (ECPA) was to encourage the construction of more energy-efficient buildings. BEPS would create a sharp disparity among the weighting factors, based on use of different energy sources. Contrary to the intent of Congress, this would encourage and allow the construction of less energy-efficient buildings, based on lower initial costs, while maintaining compliance with BEPS through selection of oil or gas.

Fourth, BEPS will significantly and unnecessarily increase future construction costs. They would require excessive administrative burdens and regulatory complexities at the federal, state, and local levels, because they are so radically different from existing practices at the state level.

Finally, we do not believe that the states will be able to implement BEPS, within reasonable time frames and reasonable estimates of available resources. This again would be contrary to the Congressional intent to create a program to be implemented at the state, not the federal, level.

Background

The concerns and arguments which I express today are not new to the DOE or to this Subcommittee. We have reviewed the transcript of the hearings you have previously held on June 5, 1980. We have reviewed many of the comments submitted to the DOE during the public comment period. We ourselves submitted detailed comments.

BEPS were first proposed in November 1978. After severe public criticisms, a revised version was proposed in November 1979. Now, I infer from the June 5 testimony of Dr. Maxine Savitz that yet another version is to be expected.

As time passes, and as the data and basic concepts used by DOE in its version of BEPS are subjected to deeper and more stringent analysis, we believe that the arguments against BEPS in their present form become stronger. We believe this will continue to be the case, as the international price of energy increases and as the Congress, the Administration, and the private sector press forward to reduce reliance on insecure foreign energy sources.

This is especially evident from the reactions of such diverse interest groups as the National Association of Home Builders and the Consumer Energy Council of America. These groups have each extensively reviewed the technical and economic data underlying BEPS and for different reasons reached the same conclusion: BEPS are seriously if not fatally flawed by the use of the so-called "weighting factors."

NCA concurs. Weighting factors, as used in BEPS, embody the concept of "source energy" performance standards. That is, in assessing the energy conservation intended to be produced by BEPS, account must be taken of all energy consumption, from the primary raw energy material to the British Thermal Units (BTUs) delivered in the space in new construction to be heated or cooled.

We recognize that DOE now defends the use of weighting factors from an economic standpoint, as representing values reached through "life-cycle cost" (LCC) analysis. We do not accept this rationale. For single family residential builidngs, the validity of the LCC analysis is suspect because of the data input and assumptions made for the various fuels and regions involved. No LCC analysis at all has been done with respect to the balance of the new construction which would be subject to BEPS, but the applicable weighting factors are similar.

It is from this basic policy decision by DOE to address BEPS in the light of source energy, or net energy consumption "back to the hole in the ground," that virtually all of the major non-technical problems identified by NCA and others arise. It is only by the amendment of BEPS to eliminate the use of weighting factors and the source energy concept that a workable program, consistent with the intent of the Congress, can be developed.

We believe this aspect of BEPS to be so important that in my statement today I will concentrate upon the use of weighting factors, and the effects they will produce which are contrary to sound national policy and interests.

BEPS Would Bias Future Fuel Choices Against Electricity, Largely Generated From Domestic Energy Resources, And Towards The Use Of Oil And Natural Gas Already Being Imported In Significant Quantities.

As I am sure the Committee is aware, BEPS would require that new construction subject to its provisions be designed so as to meet "design energy budgets" set by the DOE. In calculating compliance with such budgets, a designer would calculate the "design energy consumption" of a proposed building, expressed in BTUs per square foot per year. He would then multiply his actual projected energy consumption by a "weighting factor," depending upon the type of fuel intended to be used.

For this purpose, electricity would be considered a "fuel." The weighting factors proposed involve multiplying actual expected energy consumption by roughly three if electricity is the "fuel" of choice, by roughly 1.6 if oil is involved, and by 1.1 if natural gas is to be employed in the new construction.

This would encourage, not discourage, continued reliance upon foreign sources of energy. Our current shortfall in domestic production of oil and natural gas would be supported. Our policy to increase dependence upon domestic energy resources would be thwarted.

This result would occur because of the increasing role which coal will play in generating the nation's electricity, and the decreasing role of oil and gas. In 1978, coal generated forty-four percent of the nation's electricity, oil and gas thirty percent, and nuclear, hydropower and other sources a total of twenty percent. Projections prepared for the President's Commission on Coal and published in March 1980 disclosed that by 1985 coal will account for fifty percent of generated electricity, with oil and gas reduced to twenty-one percent and nuclear and hydro increased to twenty-nine percent. By 1990, the same source estimates coal will be used to generate fifty-four percent, oil and gas fourteen percent and nuclear and others thirty-two percent respectively.

Actual fuel consumption patterms, moreover, are already outstripping these projections. In 1979, the actual percentage shares of fuels generating electricity were coal, 47.8; oil, 13.5; gas, 14.7; and nuclear/hydro, 12.5. In the first quarter of 1979 the share of the nation's electricity generated by coal was 45.8. In the first quarter of 1980, this share had already increased to 51.6 percent.

This trend towards the use of abundant domestic energy resources to generate electricity and, thus, reduce reliance upon imported energy is the specific goal of the Administration's recent initiative to "back-out" imported oil and gas. These initiatives are now pending before the Congress. The adoption of meaningful legislation to hasten the back-out of foreign fuels will proportionately increase the share of electricity generated by coal, and thus enhance the desirability of increased, not decreased, reliance upon electricity in new construction.

BEPS Are Contrary To Our National Policy Of Conserving Scarce Nonrenewable Domestic Resources For Their Highest Uses.

The Congress and the President have repeatedly expressed a national policy of conserving scarce nonrenewable resources for their highest use. This is the clear intent of the Powerplant and Industrial Fuel Use Act (P.L. 95-620, "PIFUA"), which stresses the need to conserve natural gas and petroleum for uses "for which there are no feasible alternative fuels or raw material substitute." (PIFUA, Sec. 102)

BEPS would violate this sound national policy. There are significantly higher uses for oil and gas for which substitute fuels, such as coal, are not available or are not feasible. The highest uses of our relatively scarce domestic reserves of oil and gas are clearly essential agricultural applications, as petrochemical feedstocks and in industrial process heating.

This same policy was expressed by the President in the National Energy Plan, when he emphasized that "conserving scarce oil and natural gas is far more important than saving coal." (National Energy Plan, April 1977, at xii-xiii)

It is clear that this is still the policy of the Administration. On June 18, 1980, the President by Executive Order directed the heads of each federal agency to comply with the fuel use prohibitions of PIFUA in federal facilities. The Fact Sheet released by the White House in connection with this Executive Order concludes:

> "This Executive Order is one of a series of actions taken by the President to make the Federal Government a leader in conserving scarce oil and gas and using alternative, abundant domestic fuel. The benefits which will accrue to the Nation are reduced petroleum imports and reduced vulnerability to energy supply interruptions from foreign sources." (Fact Sheet, Executive Order, "Federal Compliance With Fuel Use Prohibitions," June 18, 1980, at 3.)

The adverse impacts of BEPS in this regard would be significant. Residential and commercial energy consumption constituted 37 percent of all domestic consumption in 1977. According to the Coal Data Book of the President's Commission on Coal, such usage will continue to represent more than one-third of all energy consumption in the 1985-90 time frames. The impact of BEPS will fall upon all new construction within this sector. It will become increasingly larger as new construction replaces old. Delivered electric energy derived from domestic reserves of coal is now and will continue to be available to substitute in the residential and commercial sector for the direct use of natural gas and oil. BEPS would frustrate this desirable result.

BEPS Will Maximize Economic Risks To Energy Consumers.

Adverse economic impacts on the energy consumer will also result from the bias against electricity contained in BEPS. On a cost-per-BTU equivalency basis, coal is and is likely to remain a significantly cheaper fuel than either gas or oil. This cost advantage will predictably be retained and reflected in the future price of electricity as regulated by state public utility commissions.

By contrast, the delivered price of oil and natural gas will rise dramatically with world oil prices and the repeal in 1985 of all federal controls on the price of natural gas.

We attach hereto a recent analysis by NCA of trends in the price of oil, coal, and natural gas delivered to utilities, for inclusion in the record.

The stated basis for the use of the proposed weighting factors is to reflect differences in life-cycle costs of new facilities based upon the source of the energy to be used, adjusted to reflect the relative national interest value in conserving different energy sources.

We believe that the life-cycle cost basis of the weighting factors is seriously deficient. In deriving and applying the factors themselves, the DOE has been forced to rely upon perhaps the most uncertain variable of all in the nation's energy equation: the future price of energy. Moreover, as now proposed, the weighting factors were based upon future oil and gas prices established on a national level.

The effect of BEPS will thus be to compel fuel choices based upon the most uncertain of future events, the price of fuel alone.

In fact, however, from an economic standpoint fuel choices can be most efficiently made at the powerplant level. Electricity is now and will continue to be generated by use of a variety of renewable and nonrenewable resources. As future fuel prices and availabilities change, powerplants and utility systems will be able to shift to the most economically efficient available fuel source or combination of sources.

By contrast, individual owners of residential or commercial buildings will have less flexibility. After initial design of a building, conversion to or from electricity, oil and natural gas will be more difficult. The energy consumer will thus be locked in to the original design choice, and subject to all of the resulting economic risks.

BEPS Would Encourage Construction Of Less Energy-Efficient Buildings.

The use of weighting factors would penalize the designer proposing to use electricity for space heating and cooling. Under BEPS, fuel choices by the designer will allow him to "save" BTUs in his design energy consumption estimates by relying upon oil or natural gas. This "saving" in turn will allow the use of less efficient energy conservation technology in the building itself. And, of course, this use of less efficient energy conservation technology will be cheaper in the short term. The new building will be less expensive, but less energy efficient.

This result is clearly contrary to the intent of the Congress in the enabling legislation. In ECPA, the Congress intended to encourage energy-efficient buildings, not fuel choices. The Chairman of this Subcommittee was one of the floor managers of the enabling legislation. Senator Johnston reiterated at the hearing on June 5, 1989 that the Congress did not intend, in legislating a program for building energy performance standards, to produce the anomaly that precisely the same building would be acceptable with the use of one fuel but unacceptable with the use of another, or in compliance with BEPS in one region but not in another.

Of perhaps equal importance, BEPS would discourage the possible use of innovative conservation technologies which rely upon electricity as the primary energy medium. These include dramatic savings in energy usage through the use of heat pumps.

Moreover, where significant use can be made of thermal energy storage devices, the availability of electricity at off-peak rates can achieve significant economic savings under innovative rate making procedures now being rapidly developed.

Finally, BEPS' discouragement of reliance upon electricity would deprive generating facilities of their ability to operate during off-peak periods at levels closer to their optimum output level. This would mean loss of efficiency in generation and producing savings in both energy and fuel costs. BEPS would significantly diminish the ability of utilities to use the most efficient load growth management and distribution methods as a means of both conserving energy and reducing the cost of energy delivered to the consumer.

BEPS Will Unnecessarily Impose Excessive Administrative And Regulatory Complexity Upon The Construction Industry.

Actual implementation of the standards now set forth in BEPS will occur under regulations not yet proposed. The actual impact of BEPS in the real world will be determined in large part by the manner in which they will be implemented under this rulemaking.

From the standpoint of the construction industry, however, BEPS as now proposed are extremely complex. They require detailed and sophisticated technical and economic judgments and evaluations. The use of computer modeling will be necessary to determine the design energy consumption of a proposed building, and its compliance with the applicable design energy budget. We are persuaded that the resources needed for such calculations do not now exist within the construction industry.

Even where the competence to make such determinations does exist, multiple calculation and comparison of initial capital costs and operating costs over the life of the building would be required fully to implement the thrust of BEPS. The need to perform these complicated and novel calculations will significantly increase the cost of future building design and construction.

The States Will Not Be Able To Implement BEPS As Intended By The Congress.

The stated intent of ECPA is to utilize existing state and local building codes to implement the program created by Sec. 302(a)(4), now proposed in the form of BEPS.

As now drafted, BEPS are clearly beyond the capacity of most state governments to implement. In a recent review of this question, the General Accounting Office has noted that states will not only be unable to meet the deadlines mandated in BEPS, but that massive technical and financial assistance to the states would be required to implement the program. This would create a substantial new federal bureaucracy.

I noted with interest that Deputy Assistant Secretary Savitz of the DOE on June 5, 1980 committed the DOE to a major program of education and assistance to the states in this regard. I submit, however, that the issue should not be whether the DOE is willing to create for itself a major new bureaucracy. This issue should, rather, be whether this result is required by the congressional mandate to create BEPS.

It clearly is not. Extensive testimony before this Subcommittee has demonstrated the number and nature of state building codes that have been adopted since enactment of related legislation in 1976. Of the forty-four states which have so acted, only two have chosen to implement performance standards containing the use of weighting factors, and embodying the concept of resource-based energy.

The other state laws, and the vast majority of building and engineering codes in force at the present time, do not utilize the resource energy concept. They establish performance standards which are directed at energy consumption and conservation at the site of the building itself. They thus directly encourage increased energy conservation in new construction.

The regulatory complexity and inefficiency which I have briefly noted is a direct result of the degree to which DOE has departed in BEPS from the approach taken by states and, I submit, the approach intended by the Congress. The major new bureaucracy and massive commitment of federal resources described by prior witnesses before this Subcommittee is not necessary.

CONCLUSION

For all these reasons, the Congress should at a minimum discourage rulemaking at this time. The substantive questions raised before this Subcommittee and the DOE with respect to the BEPS program should be reviewed in detail by the public and the Congress before final regulatory action is taken on either aspect.

In substantive final rulemaking, the concept of weighting factors should be abandoned. BEPS promulgated in compliance with ECPA should be directed toward energy consumption at the site (i.e., stated in terms of heat loss per square foot for a building thermal envelope, or in terms of component energy consumption). This would properly direct the thrust of BEPS to the amount of energy consumed at the building site, eliminate improper disincentives to the use of more abundant domestic energy resources, provide the maximum incentive for the construction of the most energy-efficient new buildings, and most cloxely approximate the regulatory mechanisms and methodologies now in use at the state and local level.

NATIONAL COAL ASSOCIATION

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CARL E. BAGGE
President

April 22, 1980

MEMORANDUM FOR: NCA Members

FROM: Carl E. Bagge

SUBJECT: Trends in the Price of Oil, Coal and Natural Gas Delivered to Utilities

I believe you will be interested in the latest additions, covering the fourth quarter of 1979, to the attached graph and table showing nationwide average prices of oil, coal and natural gas delivered to utilities. Briefly, from the last quarter of 1978 to the last quarter of 1979, nationwide average prices per million Btu's increased as follows:

. Coal	- up $ .13 (from $1.152 to $1.281)
. Natural Gas	- up $ .41 (from $1.427 to $1.842)
. Oil	- up $1.49 (from $2.248 to $3.743)

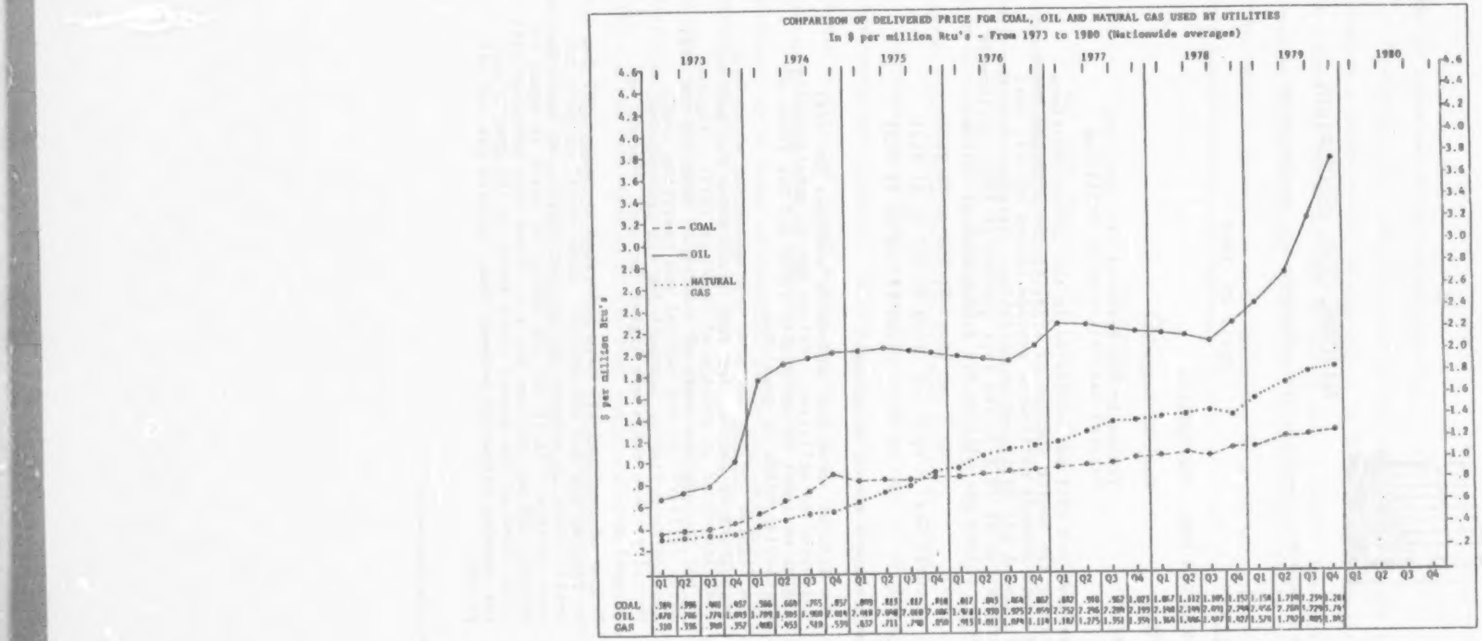
Three cautions should be noted:

- The figures shown are nationwide averages for fuel delivered to utilities. Prices may be substantially higher or lower in particular areas and for fuels of particular kinds or qualities.
- The figures include costs of transportation which have been going up rapidly for coal (rail rates for hauling coal increased an average of 20.9% in 1979). Figures do not include the costs of storing or handling the fuel after delivery, or the capital and operating costs (including pollution control) for the powerplants. Normally these costs are higher for coal than oil or natural gas.
- Prices of residual oil have moderated in early 1980 due to reduced use and oversupply. Some suppliers have cut resid prices by several dollars per barrel, at least for spot markets. (A $1 cut per barrel of resid is equal to about $.159 per million Btu's.) These cuts probably will slow somewhat the upward trend shown on the graphs and the growing disparity between coal, natural gas and oil prices.

NCA--4/22/80

COMPARISON OF DELIVERED PRICE FOR COAL, OIL AND NATURAL GAS USED BY UTILITIES

In $ per million Btu's - From 1973 to 1980 (Nationwide averages)



NOTES: . The figures shown are nationwide averages for fuel delivered to utilities. Prices may be substantially higher or lower in particular areas and for fuels of particular kinds or qualities.

. The figures shown include the costs of transportation (which have been going up rapidly for coal) but do not include the costs of storing or handling the fuel after delivery, or the capital and operating costs (including pollution control) for the powerplants. Normally, these costs are higher for coal than oil or natural gas.

. Source: FERC Form 423

		OIL		GAS		COAL	
1977	JANUARY	2.175		1.111		.859	
	FEBRUARY	2.239		1.235		.880	
	MARCH	2.286		1.211		.899	
	APRIL	2.270		1.256		.901	
	MAY	2.233		1.256		.918	
	JUNE	2.185		1.305		.933	
	JULY	2.176		1.317		.962	
	AUGUST	2.176		1.354		.943	
	SEPTEMBER	2.186		1.384		.980	
	OCTOBER	2.208		1.394		1.005	
	NOVEMBER	2.172		1.349		1.017	
	DECEMBER	2.150		1.306		1.068	
1978	JANUARY		2.148		1.364		1.067
	FEBRUARY	2.078		1.351		1.021	
	MARCH	2.096		1.402		1.134	
	APRIL	2.131	2.144	1.402	1.446	1.109	1.112
	MAY	2.137		1.435		1.106	
	JUNE	2.099		1.493		1.120	
	JULY	2.050	2.091	1.498	1.487	1.102	1.105
	AUGUST	2.056		1.494		1.100	
	SEPTEMBER	2.112		1.466		1.114	
	OCTOBER	2.198	2.248	1.471	1.427	1.140	1.152
	NOVEMBER	2.256		1.411		1.156	
	DECEMBER	2.261		1.393		1.159	
1979	JANUARY	2.318	2.456	1.502	1.578	1.158	1.158
	FEBRUARY	2.456		1.591		1.146	
	MARCH	2.614		1.628		1.168	
	APRIL	2.646	2.760	1.647	1.742	1.201	1.210
	MAY	2.741		1.775		1.211	
	JUNE	2.893		1.795		1.219	
	JULY	3.118	3.229	1.785	1.805	1.222	1.234
	AUGUST	3.235		1.803		1.225	
	SEPTEMBER	3.335		1.829		1.253	
	OCTOBER	3.461	3.743	1.891	1.842	1.274	1.281
	NOVEMBER	3.631		1.803		1.277	
	DECEMBER	3.948		1.833		1.292	

Senator DURKIN. Mr. Falk.

STATEMENT OF BERNARD H. FALK, PRESIDENT, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION; ACCOMPANIED BY MACK DUNNAWAY, COUNSEL FOR INDUSTRY COUNCIL ON ENERGY PERFORMANCE STANDARDS

Mr. FALK. I am Bernard H. Falk. I am president of the National Electrical Manufacturers Association. I am testifying today on behalf of the Industry Council on Energy Performance Standards or ICEPS, which is an umbrella organization of the electrical industry.

With me today is Mack Dunnaway, ICEPS counsel.

ICEPS represents electrical workers, contractors, utilities, public power systems, rural electrical cooperatives, distributors, and electrical manufacturers.

We are not here today looking for a change in the law. In our judgment, title III of the Energy Conservation and Production Act gives the DOE all the authority it needs to insure a high level of energy savings in buildings.

But we are concerned with the way that DOE is attempting to implement that law.

Charged with insuring the energy efficiency of new buildings, DOE has, instead, tried to develop a fuels policy that, in the end, is contrary to the purposes and conclusions of the act and to stated national energy goals, as well.

The law mandated standards to increase energy efficiency in new buildings, but the BEPS rulemaking has produced little in the way of usable results.

We believe that this unfortunate state of affairs could have been avoided if DOE had followed the simple instruction given by Congress: BEPS should insure that all new buildings will be energy efficient regardless of what energy form is used.

Much of the criticism leveled against the proposed BEPS stems directly from DOE's misguided attempt to base the standards on the types of energy used in the buildings rather than on the thermal efficiency of the buildings.

First, with utilization factors, then with weighting factors, DOE tried to extend the reach of the standards from the building line back to the powerplant, back to the refinery and, ultimately, to the mine or to the well.

It did so with no authority from Congress. Indeed, its spokesmen admit to having no stated authority but claim that, where the law is silent on this factor, the factor being weighted factors, they can write between the lines.

Unfortunately, between those lines, DOE has inserted a concept that has an effect directly contradictory to stated national energy goals.

This source energy concept that they are applying would increase—not decrease—the use of oil and natural gas in building. It would discourage the use of electricity regardless of the abundance of the fuel used to generate the electrical power.

In the proposed rule, DOE's preoccupation with the type of fuel used was embodied in weighting factors and the lifecycle costing method of deriving energy budgets.

And weighting factors, I must say, are, without question, the single most controversial feature of the proposed standard.

Public hearings held by the DOE earlier this year, 225 of the 260 witnesses who spoke about weighting factors were opposed to them.

It should be clear to DOE that to continue with the weighting factors in the face of such opposition threatens the entire BEPS program.

Yet, DOE has so far refused to abandon source-based standards.

Now, even if Congress has authorized DOE to establish fuel priorities in new buildings—which it did not—it is difficult to imagine a program that is more at odds with basic national and international energy policies.

Virtually, every piece of energy legislation enacted since the 1973 oil embargo has emphasized the critical importance of decreasing this country's use of oil and natural gas and increasing our use of abundant coal supplies and other noncritical energy sources.

At the Venice summit, world leaders agreed that nations must cut all of our dependence on oil and make more use of coal and nuclear power.

Yet, the BEPS weighting factors would produce opposite results.

In our view, the controversy over weighting factors has obscured the single most important issue in this rulemaking.

BEPS should insure the design of energy-efficient buildings without regard to the source of their energy.

In other words, BEPS should reflect one important unarguable aspect of national energy policy: The conservation of energy in buildings. It should do this rather than attempt to set national fuel policy by discriminating between conventional energy forms.

After all, national energy policy may change a number of times over the life of a building, but buildings cannot easily be changed to reflect national energy policy.

It just makes good sense, I think, to determine building efficiency independent of fuel selection.

Furthermore, weighting factors and the lifecycle costing methodology greatly increase, as you know, both the complexity of the standards and the uncertainty surrounding the actual budget numbers by their focus on relative fuel prices. This is unwise.

Relative fuel prices vary greatly between regions and, over time, because they reflect the complicated pattern of decisions by Congress, State and Federal agencies, foreign cartels, and individual buyers and sellers in the marketplace.

DOE's ability to project future energy prices, let alone relative energy prices is, at best, questionable.

DOE has, in reality, proposed two different standards—a stringent standard for buildings using electricity and a lenient standard for buildings using oil or natural gas.

Yet, Congress never envisioned or intended the construction of an entire class of inefficient buildings.

We firmly believe that DOE has made a serious mistake in proposing different performance standards for identical buildings in the same area of the country based solely on the energy form selected.

We have recommended to DOE that it adopt uniform standards—that is, a maximum amount of energy that new buildings may be designed to use.

Buildings should be constructed with energy efficiency in mind no matter what energy form is used. We believe this is a sounder approach because it focuses BEPS on the correct target, setting the level of energy conservation in an energy-efficient building.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Falk follows:]

TESTIMONY
OF
THE INDUSTRY COUNCIL ON ENERGY PERFORMANCE STANDARDS
BEFORE THE
SUBCOMMITTEE ON ENERGY REGULATION
OF THE
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
ON THE
DEPARTMENT OF ENERGY'S
PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS

Bernard H. Falk,
President
National Electrical Manufacturers
Association
2101 L Street, N.W.
Washington, D.C. 20037

Mr. Chairman and Members of the Subcommittee:

My name is Bernard H. Falk, and I am President of the National Electrical Manufacturers Association. I am testifying today on behalf of the Industry Council on Energy Performance Standards ("ICEPS"), which is an umbrella organization of electrical industry trade associations. In the electric utility sector, ICEPS represents private investor-owned utilities, public power systems at the federal, state and local level, and rural electric cooperatives. In the industrial sector, ICEPS represents manufacturers and distributors of power systems and electrical equipment of all kinds. Finally, in the construction sector, ICEPS represents both electrical contractors and electrical workers who build and install these systems and components. The members of ICEPS are:

- American Public Power Association
- Edison Electric Institute
- International Brotherhood of Electrical Workers
- National Association of Electrical Distributors
- National Electrical Contractors Association
- National Electrical Manufacturers Association
- National Rural Electric Cooperative Association

ICEPS was organized in response to the proposed building energy performance standards, or "BEPS", reflecting the electrical industry's concern over the effects of the standards. We have carefully studied the proposed rule and the research that led up to it, and have presented our views to DOE in every available forum.

We are not here today looking for a change in the law -- in our judgment, the Energy Conservation and Production Act ("ECPA") gives DOE all the authority it needs to ensure a high level of energy savings in buildings. But we are concerned with the way DOE is attempting to implement Title III of that law. Charged with ensuring the energy efficiency of new buildings, DOE has instead tried to develop a fuel policy that in the end is contrary to the purposes and conclusions of ECPA, and to stated national energy goals as well.

The purposes of Title III of ECPA are clear: Congress determined that buildings unnecessarily wasted significant amounts of energy, and mandated energy performance standards that would increase the energy efficiency in and of new buildings. It was Congress' firm conviction that "thermally efficient buildings can significantly reduce energy consumption and demand for fuels".[1/]

But while that purpose stands unchallenged today, the BEPS rulemaking has produced no usable results. After four years of research and development, the BEPS program is so far from satisfying its purpose that the Senate has had to give DOE two more years in which to overhaul the proposed standards before final promulgation. We believe that this unfortunate

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[1/] Report of the House Committee on Banking, Currency and Housing No. 94-377 at 7.

state of affairs could have been avoided if DOE had followed the simple instruction given by Congress -- BEPS should ensure that all new buildings will be energy efficient regardless of what energy form is used.

Much of the criticism leveled against the proposed BEPS by ICEPS and its members -- as well as the great majority of other parties interested in this rulemaking -- stems directly from DOE's misguided attempt to base the standards on the types of energy used in buildings rather than on the thermal efficiency of buildings. First with resource utilization factors, then with weighting factors, DOE tried to extend the reach of the standards from the building line back to the powerplant, the refinery and ultimately to the mine or well. It did so with no authority from Congress. Indeed, its spokesmen admit to having no stated authority, but claim that where the law is silent on weighting factors, they can write between the lines. Unfortunately, between those lines DOE has inserted a concept that has an effect directly contradictory to stated national energy goals. This "source energy" concept would increase, not decrease, use of oil and natural gas in buildings. It would discourage use of electricity, regardless of the abundance of the fuel used to generate the power. The net result is that standards based on this concept would permit the construction of less efficient buildings, so long as they use oil or natural gas rather than electricity.

In the proposed rule, DOE's preoccupation with the type of fuel used was embodied in weighting factors and the life-cycle costing method of deriving energy budgets.

Weighting factors are, without question, the single most controversial feature of the proposed standards. At public hearings held by DOE in March and April on the proposed standards, 225 of the 260 witnesses who spoke about weighting factors were opposed to them. It should be clear to DOE that to continue with the weighting factors in the face of such opposition threatens the entire BEPS program. Yet DOE has so far refused to abandon fuel-based standards.

Weighting factors in effect dictate the designer's fuel choice -- they do not place conventional energy forms on an equivalent basis, as some groups have asserted. Simply stated, DOE is attempting to set national fuels policy -- a responsibility that belongs to Congress alone. If DOE would refocus the proposed standards on the construction of energy efficient buildings, as Congress intended, rather than on the establishment of national fuels policy, a major stumbling block would be removed and opposition to the standards greatly reduced.

Even if Congress had authorized DOE to establish fuel priorities in new buildings -- which it did not -- it is difficult to imagine a program that is more directly at odds with basic national energy policy. Virtually every piece of energy legislation enacted since the Arab oil embargo of 1973 has emphasized the critical importance of decreasing the country's use of oil and natural gas and increasing our use of abundant coal supplies and other non-critical energy sources. Yet weighting factors would actually increase the demand for, and use of, natural gas in new buildings. This would not only exacerbate the dangerous imbalance between natural gas supply and demand, but would also encourage a shift away from other abundant or renewable sources of energy to natural gas. Moreover, by discouraging the use of electricity, DOE has ignored the vital role electricity must play in the Nation's energy future. Most electricity today is generated from abundant or renewable energy sources such as coal, nuclear, hydro and geothermal power. This use of our natural resources is fully consistent with the congressional objective of increasing the use of nondepletable energy sources in new buildings.

In our view, the controversy over weighting factors has obscured the single most important issue in this rulemaking: BEPS should ensure the design of energy efficient buildings without regard to their energy source. In other words, BEPS should encompass one national energy policy -- the conservation of energy in buildings -- rather than attempt to set national energy policy by discriminating between conventional energy forms. After all, national energy policy may change a number of times over the life of a building. But buildings cannot be easily changed to reflect national energy policy. It just makes good sense to determine building efficiency independently of fuel selection.

Furthermore, weighting factors and the life-cycle costing methodology greatly increase both the complexity of the standards and the uncertainty surrounding the actual budget numbers by focusing on relative fuel prices. This is unwise. Relative fuel prices vary greatly between regions and over time because they reflect a complicated pattern of decisions by

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Congress, state and federal agencies, and individual buyers and sellers in the market. DOE's ability to project accurately future energy prices, let alone relative energy prices, is at best questionable. Weighting factors are thus a poor means of optimizing energy conservation in new buildings.

From the ICEPS standpoint, DOE's use of weighting factors and misuse of life-cycle costing "put the cart before the horse." Under the proposed rule, the designer's fuel choice dictates the level of energy efficiency his building design must attain. A designer using oil or natural gas can design a less efficient and less costly building and still comply with the standards. In almost all of DOE's examples in the Notice of Proposed Rulemaking, gas-heated homes can meet the budget levels with less stringent insulation levels, less window glazing, and less efficient hot water heating technology.[2] This phenomenon is not limited to heating either -- it will occur whenever a designer switches from any electric component to one using oil or natural gas. The reason is simply that weighting factors and life-cycle costing allow relatively greater inefficiency whenever the designer chooses natural gas or oil.

ICEPS believes, however, that DOE should first decide on the appropriate level of energy consumption for a particular building design, then let the designer or consumer decide which form of energy to use. This places the decisionmaking process in its proper context. Under this approach, DOE would determine the level of energy conservation depending on climate and building type. The designer or consumer would then choose which fuel to use based on such factors as energy prices and the costs of installing and maintaining different heating and cooling systems. This would leave the decision on fuel choice to the consumer and the marketplace, where it belongs.[3]

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[2] 44 Federal Register 68150-51.

DOE has, in reality, proposed two different standards -- a stringent standard for buildings using electricity and a lenient standard for buildings using oil or natural gas. Yet Congress never envisioned or intended the construction of an entire class of inefficient buildings. ICEPS firmly believes that DOE has made a serious mistake in proposing different performance standards for identical buildings in the same area of the country, based solely on the energy form selected.

Any rational approach to BEPS must focus on the building envelope, which is relatively permanent, rather than on the fuel system or relative fuel prices, which may change a number of times over the life of a building. The economics of fuel choice are best left to consumers and the marketplace. In our view, the extreme emphasis DOE has placed on economic, as opposed to practical, considerations is counter-productive to the statutory objective of achieving maximum practicable improvements in energy efficiency. In fact, DOE's economic approach has produced a rule which, in actuality, will change the fuel mix in new buildings, but will not improve their overall efficiency. However, if the standards rested squarely on uniform budgets, without regard to the energy form used, ICEPS believes that BEPS would be greatlty simplified, and could make a major contribution to energy conservation in this country.

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[3] This would also remove the Council on Wage and Price Stability's concern that "incorrect weighting factors may produce a poorly designed building which meets the budget, rather than a well-designed one." Report of the Regulatory Analysis Review Group submitted by the Council on Wage and Price Stability on the Department of Energy's Proposed Energy Performance Standards for New Buildings at 32, f.n. 1.

ICEPS has recommended to DOE that it adopt uniform standards -- that is, a maximum amount of energy (adjusted for climate and building type) that new buildings may use for heating, cooling and providing hot water. Buildings should be constructed with energy efficiency in mind no matter what energy form is used. We believe this is a sounder approach because it focuses BEPS on the correct target: setting the level of energy conservation in an energy efficient building. Once that level is set, DOE should then analyze the standards in terms of economic cost and benefit as well as other factors enumerated in the statute. This is a straightforward, equitable approach -- an approach which is totally consistent with the congressional mandate to achieve the maximum practicable improvements in energy efficiency.

ICEPS would strongly urge DOE to use any additional time granted by Congress to reassess the use of weighting factors and life-cycle costing in BEPS. We urge the Congress to continue to oversee the process, to ensure that DOE does not pursue some oblique regulatory scheme that is inconsistent with the mandate of ECPA, and detrimental to the national interest.

Senator **Durkin**. Mr. Kimpflen.

STATEMENT OF JOSEPH KIMPFLEN, CHAIRMAN, TECHNICAL COMMITTEE, MINERAL INSULATION MANUFACTURERS ASSOCIATION, ACCOMPANIED BY KENNETH MENTZER, DIRECTOR OF MATERIALS AND STANDARDS FOR MIMA

Mr. **Kimpflen**. Senator, my name is Joseph Kimpflen. I am director of technical services for residential insulation at the Certainteed Corp.

With me is Ken Mentzer of the MIMA staff. Today, I represent the Mineral Insulation Manufacturers Association, known as MIMA.

We represent about 80 percent of the home insulation sold in this country in our membership of fiberglass and rockwall manufacturers and have a similar factor in commercial insulation.

I will try to be brief in my testimony for you. I think it is obvious that substantial documentation now exists correlating reduced energy consumption with improved thermal performance of the building envelope.

We have heard that commented on several times this morning.

This justification was used in establishing the performance levels cited in the present HUD minimum property standard and the residential building standards adopted by the Farmers Home Administration back in 1978.

Many individual agencies, associations, and building codes have attempted to upgrade the standards that they have generated—that they have issued to their own constituencies but, unfortunately, as a nation, we are always playing "catchup" as ever higher energy costs obsolete yesterday's standards.

This was the situation that existed when Congress prescribed BEPS, and it continues to exist today.

New homeowners are still being exposed to excessively high fuel bills or finding it necessary to retrofit their brandnew houses at higher costs because there is no national energy conservation standard that provides uniform thermal requirements for residential construction.

We are greatly concerned to find that BEPS, after 4 years in development, is now facing a further delay of 2 years at least before it can be utilized as a national standard.

Thus, our recommendation today: We think an interim national energy conservation standard is urgently needed. For residential construction, it should be easy to understand, simple to implement and to inspect for conformance.

It should be capable of being met with current construction techniques and either on a prescriptive basis for the components or on an overall performance basis through design tradeoffs.

We have analyzed——

Senator **Durkin**. Could I interrupt just a second? If it makes such good sense, why do we have to legislate it?

Mr. **Kimpflen**. Because it is not being followed. There is no uniform national standard at the moment.

Senator **Durkin**. But isn't it a function of education rather than legislation?

Mr. **Kimpflen**. If education could do it, I think that would be acceptable.

The studies which led to the initiation of BEPS seemed to indicate that that was not adequate; that there should, indeed, be a national standard established.

We have looked at the present Federal energy conservation standards based on what Federal agencies have today as their construction requirements and the objectives and economic justification for BEPS. We have analyzed those and their practicality in terms of current building practices.

Out of all of these, we have compared them and have compiled a statement of their equivalency based in R-values to make it easy to understand.

Our recommendation is that we use the existing Farmers Home Administration thermal performance standards as the interim national energy conservation standard for new construction.

Both HUD and the Farmers Home Administration have stated that the FmHA standards are very nearly the same as HUD's standards for electrically heated homes.

The difference in the two is that the present minimum property standard provides two levels of thermal performance, one for fossil-fuel heat and the other for electrically heated homes.

But those levels reflected the cost versus the savings based on 1977 fuel costs. And we believe that gas deregulation and subsequent fuel increases have just eliminated fuel cost differences as any rationale for differences in construction standards.

Both of these standards are in use today by thousands of builders and contractors. And while they will permit construction at thermal performance levels somewhat below BEPS, they will provide a significant improvement in residential energy conservation for new construction on a national scale.

Both the MPS and the FmHA construction requirements have an added benefit that I think will be important. They require a builder or a contractor's written certification statement of the R-value of the insulation which he has installed, plus the pipe and the manufacturer's name.

The combination of the manufacturer's product label certification statements plus the builder's statement provide a traceable responsibility for the compliance of the installed insulation with the standard.

This assurance of the R-value of the installed insulation is similarly covered in the proposed FTC rule on home insulation which will soon be in effect.

This will provide sanctions to insure its enforcement.

Mr. Chairman, we believe that it is still possible that you can address a significant part of the dilemma that exists.

I believe that full implementation and enforcement of BEPS faces an inevitable delay, particularly if the field trials and the comprehensive testing demands of so many agencies are to be met.

We, therefore, urge you to support the delay in the deadline of BEPS, but only if there can be an immediately installed, in its place, interim national standard for energy conservation for residential construction based on an upgraded HUD/FHA minimum property standard reflecting the present FmHA thermal performance levels.

Incidentally, we also believe that the ASHRAE standard 90 that has been referred to several times earlier today which now, recently, has been passed at ASHRAE, now called 90A-80, should be considered as an interim standard for new construction other than residential.

It does not offer the simplicity of the HUD/MPS but its provisions can be utilized by the architects and professional engineers who wrote it and are concerned with commercial and industrial buildings.

It can be an effective minimum standard for energy conservation in new construction.

That completes my testimony, Senator. I will be happy to answer any questions.

[The prepared statement of Mr. Kimpflen follows:]

STATEMENT OF
JOSEPH F. KIMPFLEN, CHAIRMAN, TECHNICAL COMMITTEE
MINERAL INSULATION MANUFACTURERS ASSOCIATION (MIMA)

BEFORE THE
ENERGY REGULATION SUBCOMMITTEE
SENATE ENERGY AND NATURAL RESOURCES COMMITTEE
WASHINGTON, D.C.
JUNE 26, 1980

MINERAL INSULATION MANUFACTURERS ASSOCIATION
382 SPRINGFIELD AVENUE
SUMMIT, NEW JERSEY
(201) 277-1550

Mr. Chairman, members of the committee, I am Joseph F. Kimpflen, Director of Technical Services for Residential Insulation at the CertainTeed Corporation, in Valley Forge, Pennsylvania. Today, I am representing the Mineral Insulation Manufacturers Association (MIMA) which includes in its membership the primary producers of Mineral Wool Insulation products. These products (including Fiber Glass) comprise about 80% of the home insulation sold in this country and are a similar factor in commercial and industrial insulation. My colleague is Ken Mentzer, Director Materials and Standards of MIMA.

We appreciate the opportunity to testify in this committee's review of the Building Energy Performance Standards program because our industry has been concerned with and involved in the development of BEPS from its inception. MIMA has for many years actively participated in efforts to achieve the national goals of reduced energy consumption through the improved thermal performance of buildings. Our earlier efforts included support of the revisions of the FHA Minimum Property Standards Thermal Requirements in 1971 and 1972 and participation in the writing of the ASHRAE Energy Conservation Standard 90-75.

Substantial documentation now exists correlating reduced energy consumption with improved thermal performance of the building envelope, and such data has provided the economic

JUSTIFICATION FOR THE PERFORMANCE LEVELS CITED IN THE LATEST HUD/FHA MPS AND THE RESIDENTIAL BUILDING STANDARDS ADOPTED BY THE FARMERS HOME ADMINISTRATION IN 1978.

NUMEROUS STUDIES OF OUR NATIONAL ENERGY SHORTFALL PROBLEM HAVE ESTABLISHED THAT ENERGY CONSERVATION IS THE MOST PAINLESS, LEAST COSTLY AND EFFECTIVE MEANS OF EXTENDING OUR LIMITED ENERGY SUPPLIES. FOR THIS REASON, THE NEED TO ESTABLISH MORE EFFECTIVE BUILDING THERMAL PERFORMANCE STANDARDS HAS BEEN WELL RECOGNIZED. INDIVIDUAL AGENCIES, ASSOCIATIONS AND BUILDING CODES HAVE ATTEMPTED TO UPGRADE THE STANDARDS ISSUED TO THEIR OWN CONSTITUENCIES; BUT UNFORTUNATELY AS A NATION, WE ARE ALWAYS PLAYING CATCH UP, AS EVER HIGHER ENERGY COSTS OBSOLETE YESTERDAY'S STANDARDS. THIS WAS THE SITUATION WHICH EXISTED WHEN CONGRESS PRESCRIBED THE NATIONAL CONSTRUCTION STANDARDS OF THE BEPS PROGRAM, AND IT CONTINUES TO EXIST TODAY.

IT IS MOST UNFORTUNATE THAT NEW HOMEOWNERS ARE STILL BEING EXPOSED TO EXCESSIVE FUEL BILLS OR FIND IT NECESSARY TO RETROFIT THEIR NEW HOMES AT HIGHER COSTS, BECAUSE THERE IS NO NATIONAL ENERGY CONSERVATION STANDARD THAT PROVIDES UNIFORM THERMAL REQUIREMENTS FOR RESIDENTIAL CONSTRUCTION.

IT IS THEREFORE OF GREAT CONCERN TO FIND THAT BEPS, AFTER FOUR YEARS IN DEVELOPMENT, IS NOW FACING A FURTHER DELAY OF UP TO TWO YEARS BEFORE IT CAN BE UTILIZED AS A NATIONAL STANDARD. IT IS FOR THIS REASON THAT WE ADDRESS OUR RECOMMENDATION TO YOU TODAY.

AN INTERIM NATIONAL ENERGY CONSERVATION STANDARD IS URGENTLY NEEDED. FOR RESIDENTIAL CONSTRUCTION, IT SHOULD BE EASY TO UNDERSTAND, SIMPLE TO IMPLEMENT, AND TO INSPECT FOR CONFORMANCE. IT SHOULD BE CAPABLE OF BEING MET WITH CURRENT CONSTRUCTION TECHNIQUES ON EITHER A PERSCRIPTIVE BASIS FOR WALLS, CEILINGS, AND FLOORS, OR AN OVERALL PERFORMANCE BASIS THROUGH DESIGN TRADEOFFS.

THE TECHNICAL COMMITTEE OF MIMA HAS MADE AN ANALYSIS OF THE CURRENT FEDERAL ENERGY CONSERVATION STANDARDS BASED ON:

- PRESENT FEDERAL AGENCY CONSTRUCTION REQUIREMENTS
- THE OBJECTIVES AND ECONOMIC JUSTIFICATION OF BEPS
- THEIR PRACTICALITY IN TERMS OF CURRENT BUILDING PRACTICES

A COMPARISON OF THESE STANDARDS HAS BEEN COMPILED SHOWING THE THERMAL REQUIREMENTS STATED IN R-VALUES FOR THE HUD/MPS, THE RCS PROGRAM, THE FARMERS HOME ADMINISTRATION (FMHA) CONSTRUCTION REQUIREMENTS,AND BEPS. AS A RESULT, MIMA RECOMMENDS THE USE OF THE EXISTING FMHA THERMAL REQUIREMENTS AS THE INTERIM NATIONAL ENERGY CONSERVATION STANDARD FOR NEW RESIDENTIAL CONSTRUCTION. AS BOTH HUD AND FMHA HAVE STATED, THE FMHA STANDARDS ARE VERY NEARLY THE SAME AS THE HUD/MPS REQUIREMENTS FOR ELECTRICALLY HEATED HOMES. THE DIFFERENCE IN THE TWO IS THAT THE PRESENT MPS PROVIDES TWO LEVELS OF THERMAL PERFORMANCE; ONE FOR FOSSIL FUEL HEAT AND ONE FOR ELECTRIC HEAT. THESE LEVELS REFLECTED COST VERSUS SAVINGS ESTIMATES BASED ON 1977 FUEL COSTS, HOWEVER, GAS DEREGULATION AND SUBSEQUENT FUEL OIL INCREASES HAVE ELIMINATED FUEL COST DIFFERENCES AS A RATIONALE FOR DIFFERENCES IN

CONSTRUCTION STANDARDS. BOTH STANDARDS ARE IN USE BY BUILDERS AND CONTRACTORS TODAY, AND WHILE THEY PERMIT CONSTRUCTION AT THERMAL PERFORMANCE LEVELS SOMEWHAT BELOW BEPS, THEY WILL PROVIDE A SIGNIFICANT IMPROVEMENT IN RESIDENTIAL ENERGY CONSERVATION FOR NEW CONSTRUCTION ON A NATIONAL SCALE.

THE HUD/MPS AND THE FMHA CONSTRUCTION REQUIREMENTS HAVE THE ADDED BENEFIT OF REQUIRING A BUILDER OR CONTRACTOR'S WRITTEN CERTIFICATION STATEMENT OF THE R-VALUE FOR THE INSULATION WHICH HE HAS INSTALLED, PLUS THE TYPE AND MANUFACTURER'S NAME. THE COMBINATION OF THE MANUFACTURER'S PRODUCT LABEL CERTIFICATION STATEMENTS AND THE BUILDER'S STATEMENT PROVIDE A TRACEABLE RESPONSIBILITY FOR THE COMPLIANCE OF THE INSTALLED INSULATION. THIS ASSURANCE OF R-VALUE OF THE INSTALLED INSULATION IS SIMILARLY COVERED IN THE PROPOSED FTC RULE ON HOME INSULATION WHICH WILL PROVIDE SANCTIONS TO INSURE ITS ENFORCEMENT.

MR. CHAIRMAN, WE BELIEVE THIS COMMITTEE CAN ADDRESS A SIGNIFICANT PART OF THIS DILEMMA IN THE AMENDMENT BEING CONSIDERED FOR THE HOUSING AND COMMUNITY DEVELOPMENT ACT OF 1980. A DELAY IN THE FULL IMPLEMENTATION AND ENFORCEMENT OF BEPS SEEMS INEVITABLE, PARTICULARLY IF THE FIELD TRIALS AND COMPREHENSIVE TESTING DEMANDS ARE MET. WE, THEREFORE, URGE YOU TO GRANT THE DELAY IN THE DEADLINE FOR IMPLEMENTING BEPS WHICH SEEMS TO BE NEEDED, BUT IMMEDIATELY INSTALL IN ITS PLACE

AN INTERIM NATIONAL ENERGY CONSERVATION CONSTRUCTION STANDARD FOR RESIDENTIAL CONSTRUCTION BASED ON AN UPGRADED HUD/FHA MINIMUM PROPERTY STANDARD MODIFIED TO REQUIRE THE SINGLE THERMAL PERFORMANCE LEVELS IN THE FARMERS HOME ADMINISTRATION STANDARD.

WE FURTHER BELIEVE THAT ASHRAE STANDARD 90.1 - 75 (R) SHOULD BE CONSIDERED AS AN INTERIM STANDARD FOR NEW CONSTRUCTION OTHER THAN RESIDENTIAL. WHILE NOT OFFERING THE SIMPLICITY OF THE HUD/MPS, ITS PROVISIONS CAN BE UTILIZED BY THE ARCHITECTS AND PROFESSIONAL ENGINEERS INVOLVED WITH COMMERCIAL AND INDUSTRIAL BUILDINGS AS AN EFFECTIVE MINIMUM STANDARD FOR ENERGY CONSERVATION IN NEW CONSTRUCTION.

MR. CHAIRMAN, WE THANK YOU FOR THIS OPPORTUNITY TO EXPRESS OUR VIEWS AND WILL ATTEMPT TO ANSWER ANY QUESTIONS WHICH THE COMMITTEE MAY HAVE.

RESIDENTIAL ENERGY CONSERVATION STANDARDS (Stated in R-values)

HEATING DEGREE DAYS	HUD/MPS, RCS[1]			FmHA			BEPS[3]		
	WALLS	CEILINGS	FLOORS	WALLS	CEILINGS	FLOORS	WALLS	CEILINGS	FLOORS
0-1000	11 (11)[2]	19 (19)	- -	11	19	11	-	-	-
1001 - 2500	11 (13)	19 (22)	- -	13	22	13	11 (19)[2] 19 (19)	30 (38) 38 (38)	- - - -
2501 - 3500	11 (19)	22 (30)	(11)	19	30	19	19 (19)	30 (38)	11 (11)
3501 - 4500	11 (19)	30 (30)	11 (19)	19	30	19	(27)	(38)	-
4501 - 5000	11 (19)	30 (30)	11 (19)	19	30	19	19 (27)	38 (38)	19 (19)
5001 - 6000	11 (19)	30 (30)	11 (19)	19	30	19	-	-	-
6001 - 7000	11 (19)	30 (38)	11 (19)	19	38	19	19 (27)	38 (38)	- -
7001 - ABOVE	19 (19)	38 (38)	19 (19)	19	38	19	19 (27)	38 (38)	- -

(1) RCS as a retrofit program does not supply specific wall R-values.

(2) Numbers in brackets are electric heat requirements.

(3) R-values based on information from BEPS TSD 3 for Houston, Ft. Worth, Atlanta, Washington, D.C.; Portland, O.; Chicago, Minneapolis.

NOTE: For simplicity glazing recommendations are not duplicated. Glazing recommendations are a part of every energy conservation standard.

Senator **DURKIN**. I think you know—I don't know of anyone in the Senate who has spent more time on energy efficiency and conservation than I have.

Senator Kennedy and I introduced comprehensive legislation last year to lukewarm response from the White House.

But my basic concern is, watching DOE, I am not sure they could handle a two-car funeral. And here we are going to give them the authority to implement even an interim standard without some check on it.

I am very pessimistic in light of their past performance.

Mr. **KIMPFLEN**. Well, sir, the HUD standard and the Farmers Home Administration are well researched and they are in existence.

They are being employed now, and my recommendation would be to continue them but on a broader scale.

Senator **DURKIN**. At least, at home—I mean, one of the scariest sentences in the English language is, "I am here from the Federal Government, and I am here to help you." I mean, people run for cover.

And I am just concerned that it starts the wrong way, that it will be counterproductive.

Then, there is the whole question of insulation and new technologies, new innovative procedures of building and energy efficiency; this may stagnate that effort. The BEPS may stagnate the effort. And we will have a national consensus based on the convoy mentality: A convoy can only move as fast as the slowest ship in the convoy.

Mr. **KIMPFLEN**. I would agree, sir. I think BEPS in its present form would tend to hold up rather than accelerate this effort.

Senator **DURKIN**. Thank you.

Gentlemen, your statements will be included in their entirety.

Now, panel No. 6: Mr. Turnbull, Mr. Gibson, and Mr. Endahl, please.

STATEMENT OF THOMAS F. GIBSON, BRICK INSTITUTE OF AMERICA

Mr. **GIBSON**. Mr. Chairman, my name is Thomas Gibson. I am director of Government relations for the Brick Institute of America. We are the technical trade association for the manufacturers of brick and other structural clay products, representing about 90 percent of the brick produced in this country.

And, if you are dying of curiosity, that's about 9 billion bricks a year.

The businesses of our members will be directly affected by the content, timing, and implementation of BEPS. And it is on these three issues that I will make brief summary comments.

A comment on the technical merit of BEPS was contained in our rather lengthy submission to the subcommittee's June 5 hearing.

We are deeply committed to buildings that make greater use of our energy resources and, to that end, we have demonstrated such a commitment in many of our research and marketing programs.

To that end, we also favor cost-effective energy performance standards for buildings.

Considerable critical comment has already been heard on the content and technical merit of the current BEPS proposal. Yet, we are encouraged by three particular features of BEPS.

The first is that it is the beginning of an effort toward a performance approach to energy conservation. The second is that it encourages the use of solar and other nonrenewable energy resources. And the third, and a more technical aspect, applying to brick masonry, in the standard evaluation technique, DOE-2, the computer analysis recognizes that there is a difference in performance of light-weight building elements versus massive masonry elements with the same levels of insulation.

This fact, unfortunately, was not reflected in the preamble of the proposed standards.

We have also been encouraged by the announced willingness by DOE to make the necessary refinements in BEPS before promulgation of any final rule, though I would suggest that their proposed time frame for doing so is ambitious, to say the least.

It is patently obvious that DOE has not had enough time to develop a standard which we, the members of the building community, will be living with for decades to come.

The energy budgets are not based on adequate data. There is no procedure to establish compliance through documented actual performance. And the DOE-2 computer program that constitutes the only standard evaluation technique (SET) has been under continuous revision and modification since before the notice of the proposed rulemaking.

This fact of continuous modification of the SET raises considerable doubts about the design energy budgets that were supposedly used in developing the program.

Many of our doubts about DOE's data base and methodology were confirmed by our engineering and research department via computer studies on five houses in the Washington area upon which BIA had complete energy consumption statistics over the last several years.

At significant cost, we contracted Steven Winter Associates of New York to run a DOE-2 program to compute the design energy budgets of the five houses.

The results are telling. In two of the houses located in Poolesville and Mt. Airy, Md., the actual yearly consumption on a Btu per square foot per year basis was nearly half of what the DOE program said it would be—or, should I say, projected what it would be.

Both houses had electric resistance heating. In a Fairfax County home, heated by oil and cooled by electricity, the BEPS DOE-2 design energy budget missed the mark by about 25 percent.

Senator DURKIN. You mean, consumption was 25 percent higher?

Mr. GIBSON. Lower. I should also add that these are energy-efficient homes that we had a hand in the design and construction of, some having brick walls and others not.

In light of such data, we are gratified that DOE has recognized the many shortcomings of the original proposal and is moving to resolve them by proposing alternative methods of compliance and refined methodology.

In recognizing that delay of BEPS is somewhat assured, we would make the following suggestions to insure time for the expansion of the current data base, that there is proper refinement of the methodology used for compliance, field testing of theoretical models, and a final review of all pertinent facts before final implementation.

One year should be provided for DOE to correct the deficiencies present in the current standard. A combined notice of proposed rulemaking and their implementing regulations should be made in June of 1981 and followed by an appropriate period for public comment.

After proper and thorough review of the comments, the final standards and their implementing regulations should be made. January of 1982 seems a reasonable date for the issuance of such final standards.

A period of voluntary compliance of at least 2 years should then occur. During this time, the impact of the program could be assessed and a determination made as to the final making of BEPS mandatory, whether or not it should be.

In the meantime, education, study, and compliance assistance programs should be undertaken to engender the understanding and good will of the American building community.

I would suggest that, if this does not occur and an adversary relationship is perceived by the builders, BEPS, if made mandatory, would be largely unenforceable.

I would further suggest that the original intent of Congress should be continuously brought to mind throughout this process.

The product of BEPS should be more energy-efficient buildings and conservation of nonrenewable energy resources.

The simple fact has been in danger of becoming lost in the overall rush to meet imposed deadlines and in the mechanics of the rulemaking process.

The success or failure of this proposed standard will depend solely on whether its application does, in fact, save energy, not on whether or not it was promulgated within a specific time frame.

It is our shared belief that the projected costs of the current BEPS in terms of dollars and energy do not compare favorably with the projected benefits.

And in view of the current economic realities of the construction marketplace, we cannot afford an expensive rule that might further depress residential and commercial building without knowing if it will, indeed, work. Thank you.

[The prepared statement of Mr. Gibson follows:]

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TESTIMONY PRESENTED
to the
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
SUBCOMMITTEE ON ENERGY REGULATION
on
BUILDING ENERGY PERFORMANCE STANDARDS

BY

Thomas F. Gibson

Brick Institute of America

June 26, 1980

My name is Thomas Gibson, I am the Director of Government Relations for the Brick Institute of America, BIA is the technical trade association for the manufacturers of brick and other structural clay products throughout the United States.

The businesses of our members will be directly affected by the content, timing and implementation of the Building Energy Performance ds, and it is on these three issues that I will make summary (Comment on the technical merits of BEPS was contained bmission to this subcommittee's June 5th hearing.)

The brick industry has favored and promoted energy efficient buildings since long before the 1973 Arab Oil Embargo highlighted America's high-cost energy habit. BIA has taken several initiatives to encourage the design and manufacture of energy efficient buildings, among them being our pioneering efforts in the area of passive solar design and construction, and our free consultation to the Department of Energy on matters of commercializing energy efficient manufactured products. Further, BIA recently undertook the co-sponsorship of a nationwide passive solar design competition in which over 2,200 fourth and fifth year architectural students participated. The BIA design competition was aimed at promoting creative energy efficient concepts which are certain to be the way of the future. We are deeply committed to buildings that make greater use of our energy resources and to that end, we favor cost effective energy performance standards for buildings.

Considerable comment has already been heard on the content and technical merit of the current BEPS proposal. We are encouraged by three particular features of the initial BEPS proposal:

1) It is a beginning effort toward the performance approach to energy conservation.
2) It encourages the use of solar energy and other renewable resources.
3) In the standard evaluation technique (DOE-2), the computer analysis recognizes that there is a difference in performance of lightweight building elements versus massive masonry elements with the same insulation levels. This fact, unfortunately, is not reflected in the preamble to the proposed standards, nor in the Technical Support Documents (TSD's).

We have also been encouraged by the announced willingness by the Department of Energy to make necessary refinements in BEPS before promulgation of any final rule.

It is patently obvious that DOE has not had enough time to develop a standard, which we in the building community will be living with for decades to come. The energy budgets are not based on adequate data, there is no procedure to establish compliance through documented actual performance, and the DOE-2 computer program, that constitutes the only standard evaluation technique, has been under continuous revision and modification since before the notice of proposed rule-making. This fact of continuous modification of the SET raises considerable doubts about the Design Energy Budgets that were supposedly developed using the program.

Many of our doubts about DOE's data base and methodology were confirmed by our Engineering and Research Department via computer studies on five houses in the Washington area, upon which BIA had complete energy consumption statistics. At significant cost, we contracted with Steven Winter Associates of New York to run the DOE-2 program to compute the design energy budgets of the five houses. The results are telling: In two of the houses located in Poolesville, and Mt. Airy, Maryland, the actual yearly consumption on a Btu per square foot per year basis, was nearly half of what the DOE-2 program projected it would be. Both houses had electirc resistance heating. In a Fairfax County home, heated by oil and cooled by electricity, the BEPS DOE-2 Design Energy Budget missed the mark by 25 percent.

In light of such data, we are gratified that DOE has recognized the many shortcomings of its original propoasl and is moving to resolve them by proposing alternative methods of compliance, and refined methodology.

In recognizing that delay of BEPS is assured, we would make the following suggestions to ensure time for the expansion of the current data base, that there is proper refinement of the methodology used for compliance, field testing of theoretical models, and a final review of all pertinent facts before implementation.

One year should be provided for DOE to correct the deficiencies present in the current standard. A combined notice of proposed rule making and their implementing regulations should be made in June of 1981 and followed by an appropriated period for public comment. After proper and thorough review of comments, the final standards and their implementing regulations should be made. January of 1982 seems a reasonable date for issuance of final standards. A period of voluntary compliance of at least two years should then occur. During this time the impact of the program could be assessed and

and a determination made as to making BEPS mandatory. In the meantime education, study, and compliance assistance programs should be undertaken to engender the understanding and goodwill of the American building community. I would suggest that if that does not occur, and an adversary relationship is perceived, BEPS if made mandatory would be largely unenforceable.

I would further suggest that the original intent of Congress be continuously brought to mind throughout this process. The product of BEPS should be more energy-efficient buildings and conservation of non-renewable resources. This simple fact has been in danger of becoming lost in the overall rush to meet imposed deadlines and in the mechanics of the rule-making process. The success or failure of this proposed standard will depend solely on whether its application does in fact save energy, not on whether it was promulgated within a specific time frame,

It is our shared belief that the projected costs of the current BEPS, in terms of dollars and energy, do not compare favorably with the projected benefits. And in view of the current economic realities of the construction marketplace, we cannot afford an expensive rule that might further depress residential and commercial building, without knowing if it will indeed work.

I thank the committee for its time and interest on this important matter, and am most appreciative for the opportunity to testify.

TABLE 1

Source	Brick* System House	Blair** Model Home	Woodside Type A Dogwood	Woodside Type B Cottonwood	Woodside Type D White Oak
DOE/BEPS Budget H & C	Elect. 32400	Elect. 32400	Oil & Elect. 35700	Oil & Elect. 35700	Oil & Elect 35700
DOE/BEPS Budget Hot Water Heating	Elect. 21875	Elect. 21163	Elect. 14384	Elect. 18945	Elect. 19348
DOE/BEPS (predicted) Total Budget	54275	53563	50084	54645	55048
DOE-2 H & C	22222	23907	39246	47905	33131
DOE-2 H & C (required for compliance) Weighted	Elect. 62000	Elect. 66700	Oil & Elect. 47880	Oil & Elect. 58540	Oil & Elect. 40420
BIAECP Heating & Cooling only	26049	25931	53550	37300	40707
Actual Consumption Heating	—	—	23438	31605	27231
Actual Consumption All Other (Elect.)	—	—	14191	17442	18231
Total Actual Consumption	30736	35678	37629	49047	45462

*Pollesville, Maryland **Mt. Airy, Maryland **All values given in Btu/sf/yr**

Senator **Durkin**. Mr. Turnbull.

STATEMENT OF BRUCE H. TURNBULL, NATIONAL RETAIL MERCHANTS ASSOCIATION

Mr. **Turnbull**. Senator, my name is Bruce H. Turnbull, and I am an attorney with Weil, Gotshal & Manges. I am here today representing the National Retail Merchants Association.

NRMA is a national, nonprofit trade association composed of 3,500 members who operate more than 35,000 department chains and specialty stores in the general merchandise retail industry.

I would note that I am the first witness, so far as I am aware, who appears on behalf of commercial building occupants.

NRMA supports the development and implementation of performance standards for energy consumption in new buildings and opposes mandatory prescriptive standards unless they contain a performance option.

Thus, while NRMA believes that the particular building energy performance standards proposed by the Department of Energy last November are fundamentally and fatally flawed, NRMA urges DOE and Congress to continue to work toward a viable BEPS program.

We are disturbed by statements made at this subcommittee hearing on June 5 by DOE officials and others that the task to be undertaken in the coming year is the transformation of this program to a prescriptive oriented "cookbook" approach or that the BEPS program is properly viewed as insulation oriented.

The essence of a performance standard is its broad and flexible approach providing only a budget for the energy consumption of an entire building and allowing a myriad of design approaches to meet that budget without requiring the builder to follow any one recipe.

NRMA believes there is a reasonable performance-based alternative now available to replace DOE's proposed rule.

Because we think this proposal is more important than the details of NRMA's problems with the proposed rule, I will spend the balance of a minute or two discussing that.

NRMA's proposal is that DOE use the existing standard developed by the American Society of Heating, Refrigeration and Air-Conditioning Engineers, standard 90-75, as revised, and translate it to a performance standard.

Builders would then be allowed to comply with either the prescriptive or, more accurately, component performance approach of ASHRAE 90 or the design budget which would be equivalent to it.

As the table attached to my testimony shows, this would result in substantial improvements in energy consumption levels for retail buildings.

To fully appreciate the benefits of NRMA's proposal, it is necessary to understand the short but somewhat confused history of energy-related building standards.

A number of groups, including the National Bureau of Standards and individual industry experts, worked closely with ASHRAE officials to develop standard 90-75.

The process of State and local adoption of ASHRAE 90-75 began once that standard became final in 1975, and was accelerated after Congress passed, as part of the Energy Policy and Conservation Act of 1975, a grant program for State conservation programs requiring that States develop lighting and thermal efficiency standards for new commercial buildings.

The Federal Energy Administration's regulations encouraged States to use ASHRAE 90–75.

However, the Energy Conservation and Production Act passed in mid-1976 inaugurated the BEPS program and, in so doing, shifted a major part of the Federal focus to total building performance standards.

Because BEPS was a relatively long-term program and because the EPCA prescriptive mandate for State conservation programs was not changed, most States moved to adopt ASHRAE 90–75 or a close equivalent.

Today, the situation is that there is a nationally accepted prescriptive or component performance standard which is part of most State or local building codes.

As now proposed, BEPS would be a completely separate approach requiring total revamping of these State and local codes.

NRMA's proposal, in contrast, would build on the work already done by simply adding a total building performance option to the existing ASHRAE 90–75.

Even under NRMA's proposal, DOE should be given an additional year to promulgate the final rule.

That extra year should be spent carefully translating ASHRAE 90–75 into budget levels for the various building classifications and testing and retesting DOE's standard evaluation technique.

These two tasks can be performed in 1 year, and then DOE can turn to the additional task of making certain that its standard is properly adopted and enforced.

As experience is gained from the in-use standard, DOE should then propose and adopt modifications as appropriate.

I would be happy to answer any questions.

[The prepared statement of Mr. Turnbull follows:]

National Retail Merchants Association

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ORAL STATEMENT OF
BRUCE H. TURNBULL
WEIL, GOTSHAL & MANGES

ON BEHALF OF THE
NATIONAL RETAIL MERCHANTS ASSOCIATION

BEFORE THE
SUBCOMMITTEE ON ENERGY REGULATION
COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

CONCERNING THE IMPLEMENTATION OF THE
BUILDING ENERGY PERFORMANCE STANDARDS
PROGRAM

June 26, 1980

My name is Bruce H. Turnbull, and I am an attorney with Weil, Gotshal & Manges. I am here today representing the National Retail Merchants Association. NRMA is a national nonprofit trade association composed of 3,500 members who operate more than 35,000 department, chain and speciality stores in the general merchandise retail industry. Its members have an aggregate annual sales volume of nearly $100 billion and employ over 2.5 million workers. NRMA welcomes this Subcommitte's interest in the implementation of the Building Energy Performance Standard program and appreciate this opportunity to present the views of general merchandise retailing.

NRMA supports the development and implementation of performance standards for energy consumption in new buildings and opposes mandatory prescriptive standards unless they contain a performance option. Thus, while NRMA believes that the particular Building Energy Performance Standards proposed by the Department of Energy last November are fundamentally and fatally flawed, NRMA urges DOE and Congress to continue to work toward a viable BEPS program.

We are disturbed by the statements made at this Subcommittee's hearing on June 5 by DOE officials and others that the task to be undertaken in the coming year is the transformation of this program to a prescriptive-oriented "cookbook" approach or that the BEPS program is properly viewed as "insulation" oriented. The essence of a performance standard is its broad and flexible approach, providing only a "budget" for the energy consumption of an entire building and allowing a myriad of designs to meet that budget without requiring the builder to follow any one recipe. As I will discuss more fully in a couple of moments, NRMA believes there is a reasonable, performance-based alternative now available to replace DOE's proposed rule. Unlike a move to prescriptive standards, NRMA's proposal would not go back on the breadth and flexibility of performance standards, as promised by Congress in its 1976 mandate for the BEPS program.

In the past seven years, retailers have made enormous strides toward making their businesses more more energy efficient, in physical plants, equipment and operations. In the coming years, retailing, along with the rest of our society, must do even more.

The BEPS program can be an important element of these efforts. It will not, however, be useful if DOE's current proposals are adopted. NRMA's detailed statement to DOE, which has been submitted with my testimony for inclusion in the record of these hearings, contains a complete review of retailing's criticisms of the proposed rule, including NRMA's views that the budget levels for retailing are far too stringent, that the standard evaluation technique has been inadequately tested, that the impact on retailing of standards at various budget levels has not been appropriately addressed, and that the weighting factors should be discarded.

I will take time here to make only one brief point concerning these criticisms. The weighting factors were developed in large part, and with notable "success" on this point, to discourage the use of electricity in space heating. Because retailing uses very little energy of any kind for heating purposes and very large quantities of electricity for non-heating purposes, primarily lighting and air cooling, for which there are no adequate substitutes for electricity, the weighting factors cause particular hardships for retailers. This is especially the case in the majority of the country where retailers do not have access to natural gas as an alternate fuel for any purpose.

More important than the details of NRMA's problems with the proposed rule is NRMA's proposal to expediate promulgation of a final performance standard, at least for commercial buildings, while sidestepping the pitfalls of DOE's current proposal: DOE should use the existing standard developed by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), standard 90-75 (as revised), and translate it to a performance standard. Builders would then be allowed to comply with either the prescriptive (or, more accurately, component performance) approach of ASHRAE 90-75 or the design budget which would be equivalent to it. As the table attached to my testimony shows, this would result in substantial improvements in energy consumption levels for retailing, whether compared with the DOE Phase I data, DOE's

Advance Notice of Proposed Rulemaking (November 1978), or our estimation of the current practice in general merchandise retailing.

To fully appreciate the benefits of NRMA's proposal, it is necessary to understand the short but somewhat confused history of energy-related building standards. A number of groups, including the National Bureau of Standards, and individual industry experts worked closely with ASHRAE officials to develop standard 90-75. ASHRAE regularly develops building standards for a variety of purposes, and most state and local building code authorities adopt ASHRAE - recommended standards shortly after they are finalized. The process of state and local adoption of ASHRAE 90-75 began once that standard became final in 1975 and was accelerated after Congress passed, as part of the Energy Policy and Conservation Act of 1975, a grant program for state conservation programs requiring that states develop lighting and thermal efficiency standards for new commercial buildings. The Federal Energy Administration's regulations encouraged states to use ASHRAE 90-75. Thus, by mid-1976, ASHRAE and the federal government were promoting the use of a perscriptive approach to energy-related building standards.

However, the Energy Conservation and Production Act, passed in mid-1976, inaugurated the BEPS program and, in so doing, shifted a major part of the federal focus to total building performance standards. Because of BEPS was a relatively long-term program and because the EPCA prescriptive mandate for the state conservation program was not changed, most states moved to adopt ASHRAE 90-75 or a very close equivalent. Few states or localities have made these standards mandatory or enforced them with vigor. Today, the situation is that there is a nationally accepted prescriptive, and, through the modifications made by ASHRAE to 90-75, component performance, standard which is part of most state or local government building codes.

As now proposed, BEPS would be a completely separate approach, requiring total revamping of these state and local codes. NRMA's proposal, in contrast, would build on the work already done by simply adding a total building performance option to the existing ASHRAE 90-75.

Even under NRMA's proposal, DOE should be given an additional year to promulgate the final rule. That extra year should be spent carefully translating ASHRAE 90-75 into budget levels for the various building classifications and testing and retesting DOE's standard evaluation technique. Those two tasks can be performed in one year, and then DOE can turn to the task of making certain that its standard is properly adopted and enforced. As experience is gained from the in-use standard, DOE should propose and adopt modifications as appropriate.

I will be happy to answer questions you may have.

TABLE I*

STANDARDS VS. ASHRAE

(BUILDING LINE ENERGY)

	PHASE I	ANOPR	CURRENT DESIGNS	ASHRAE-EQUIVALENT	NOPR
NORTH	112	96	90	75	65
SOUTH	94	78	75	67	58

in MBTU/sq. ft./yr.

* The table is based on information provided by one NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores. All figures are based on interpretations of computer models constructed using EST-I programs, and DOE's Standard Building Operating Conditions and climate information.

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COMMENTS

OF THE

NATIONAL RETAIL MERCHANTS ASSOCIATION

ON THE

NOTICE OF PROPOSED RULEMAKING

REGARDING

BUILDING ENERGY PERFORMANCE STANDARDS

DOCKET NUMBER CAS-RM-79-112

April 30, 1980

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INTRODUCTION/SUMMARY

The following are the comments of the National Retail Merchants Association ("NRMA") on the Notice of Proposed Rulemaking published at 44 Federal Register 68119 (November 28, 1979), concerning energy performance standards for new buildings.

NRMA is a national, nonprofit trade association composed of over 3,500 members operating more than 35,000 department, chain and specialty stores in the general merchandise retail industry. Our members have an aggregate annual sales volume in excess of $95 billion and employ over 2.5 million workers. In addition, some three-fourths of our members are small businesses, with sales of less than $2 million each.

Since 1973 retailing has made great strides in improving building efficiency. We have undertaken numerous investments in conservation principally because energy prices are growing at a phenomenal rate -- two to three times faster than sales. This growth in the costs of doing business exerts tremendous pressure on retail profits which are hard for management to ignore.

Chart I, "Retail Energy Use Trends," dramatically illustrates this direct relationship between increased energy costs and increased conservation, and provides a context within which to view the Building Energy Performance Standards (BEPS) contained in the November 28, 1979, Notice of Proposed Rulemaking (NOPR). For retailing as a whole, Chart I translates into a 30 percent efficiency improvement over 1973 levels for older retail stores. Of equal importance, new stores (not displayed in the chart) are consuming 30 percent less than their most efficient, older counterparts.

NRMA firmly believes that the key to a successful performance standard is understanding these achievements and building on them. Hence, our central conclusion is that improved building efficiency should be achieved by continuing this trend toward improvement, not radical departures from it.

NRMA has consistently endorsed the concept of governmentally required energy performance standards because we recognize the value to the nation of accelerating investment in efficient designs which may be considered economically "marginal." More important, performance standards are far preferable to prescriptive standards as a means to achieve this end.

NRMA is unable, however, to support the BEPS program outlined in the NOPR, despite our past support of the concept of performance standards.[1]

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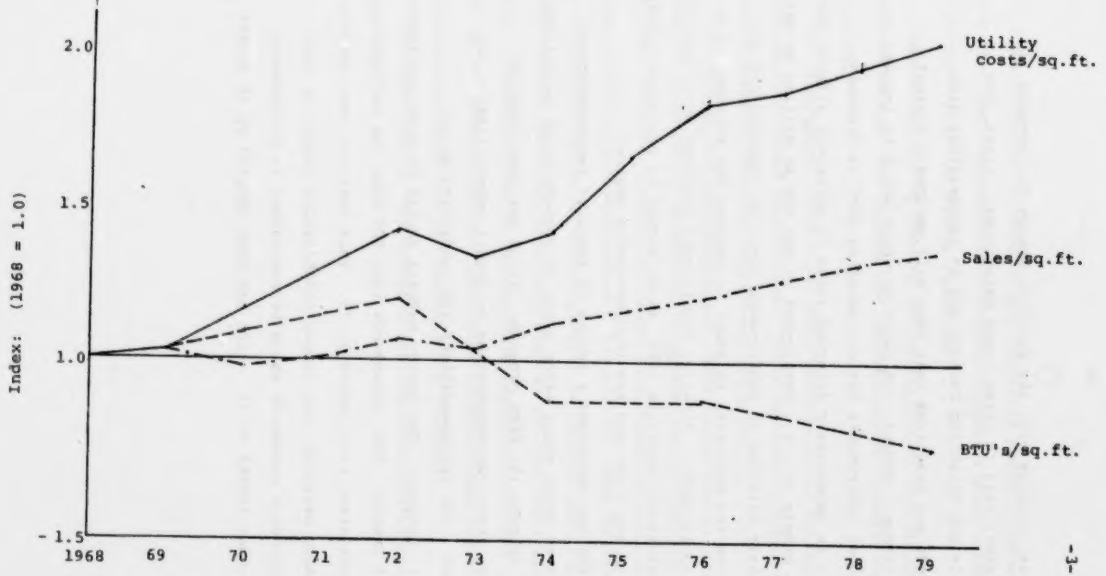
[1] NRMA endorsed the legislation which became Title III of the Energy Conservation and production act and the budget levels included in the November, 1978 Advanced Notice of Proposed Rulemaking. NRMA has never supported the concepts of RUFs and RIFs or Weighting Factors in general.

CHART I

RETAIL ENERGY USE TRENDS*



* Based on figures supplied by NRMA member corporations

Our concerns with the Building Energy Performance Standards (BEPS) fall in three broad categories. First, the budget levels and Weighting Factors are so inconsistent with current trends and practices that they will seriously disrupt retail operations. Second, the sanction which would be imposed on state and local governments for not adopting BEPS is draconian. Moreover, it is imprecisely directed since it adversely affects those required to comply -- i.e., developers -- who may be willing to design and build their building in conformance with the standard and not those who have the authority to adopt or enforce the standard (i.e., states and localities). Finally, significant problems exist with the Standard Evaluation Technique (SET) which should be corrected before the standards are finalized the implementation begins.

NRMA has developed a series of specific recommendations with respect to these three major areas of concern which we believe will vastly improve the BEPS program. It is our hope that DOE will consider these recommendations in detail before final rules are published. Our recommendations are summarized below:

1) Budgets: The energy budgets should be made consistent with current trends. NRMA recommends that DOE make the performance standards consistent with ASHRAE 90-75. This does not mean abandoning performance measures, but simply establishing bugets so that Federal performance standards would be equivalent to performance achievable under ASHRAE 90-75, which has been adopted by 38 states.

NRMA urges DOE to abandon all Weighting Factor approaches. We believe that the "marketplace" provides adequate signals with respect to the "value" of energy resources.

NRMA urges DOE to clarify the definition of process energy for retail buildings, and include the use of display lighting in the definition.

2) Sanctions: NRMA urges DOE and Congress to develop a substitute sanction which permits individuals to comply regardless of whether a state or locality adopts the standard.

3) Timing and Implementation: NRMA urges DOE, with the concurrence of Congress if necessary, to extend the time period for adopting the standards by state and local governments to a minimum of eighteen months to two years after promulgation. NRMA believes that DOE should provide an extensive program to educate both public and private sector officials about the program and its compliance mechanisms. NRMA urges DOE to refrain from making significant revisions in the program for at least three to four years and tie such revisions to changes in the ASHRAE 90-75 standard.

The remainder of our comments explore retailing's concerns in greater depth.

I. THE DESIGN ENERGY BUDGETS

NRMA has three concerns with regard to the Design Energy Budgets for retail buildings included in the 1979 Notice of Proposed Rulemaking (NOPR). First, the budgets are not based on past or present trends in energy conservation. Instead, they represent a major disruption of these trends which cannot be economically justified at this time. Second, the Weighting Factors are unnecessary and heavily penalize those who must use electricity. Third, "process energy" is poorly defined, and ignores many energy uses in retail stores which are related to sales.

The Budgets Represent a Major Break with Current Trends

Table I, "Standards vs. ASHRAE," outlines the relationship among several different performance standards. Column II (ANOPR) represents the standards for a northern and southern store as contained in the 1978 Advanced Notice of Proposed Rulemaking (ANOPR). Column IV (ASHRAE-Equivalent) indicates our estimate of the performance of two stores built in accordance to ASHRAE 90-75 prescriptive standards.[2] Column V (NOPR) represents the budgets in the Proposed Rule. For reference, estimates of energy use in the Phase I data base have been included, along with an estimate of the performance of two 100,000 sq. ft. stores currently in the design phase and scheduled to open in 1981. All standards are given for both a northern and southern store.

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[2] The table is based on information provided by one NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores. The stores are currently in design. All figures are based on interpretations of computer models constructed using EST-I programs, and DOE's Standard Building Operating Conditions and climate information. The cost of this analysis was $10,000.

The table shows two important relationships: First, the jump from the ANOPR to the NOPR (96 to 64 MBTU/sq. ft./yr. in the North and 76 to 58 MBTU/sq. ft./yr. in the South) is extreme, especially since the ANOPR represents a significant improvement over Phase I. Second, buildings built today are already meeting the ANOPR budgets, but not yet meeting the "ASHRAE-equivalent." These same buildings are significantly short of meeting NOPR standards.

This table leads to one major conclusion: The NOPR standards represent a drastic departure from the trend toward increased energy efficiency. Instead, the standards will require building investment which falls much farther from the "margin" than can be economically justified.

When these standards are coupled with Weighting Factors that heavily penalize the use of electricity, they place severe burdens on retailing -- burdens which will impact not only our buildings, but our business plans and the goods and services we provide to our customers.

On the other hand, an "ASHRAE-equivalent" standard would represent a real challenge but also a realistic one. It will serve the intended purpose of the building code envisioned by Congress -- namely, to realize greater energy savings than would be possible by reliance on market forces alone -- while at the same time it would build on, rather than disrupt, current trends in energy conservation.

TABLE I*

STANDARDS VS. ASHRAE

(BUILDING LINE ENERGY)

	PHASE I	ANOPR	CURRENT DESIGNS	ASHRAE-EQUIVALENT	NOPR
NORTH	112	96	90	75	65
SOUTH	94	78	75	67	58

in MBTU/sq. ft./yr.

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* The table is based on information provided by one NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores. All figures are based on interpretations of computer models constructed using EST-I programs, and DOE's Standard Building Operating Conditions and climate information.

Moreover, the prescriptive standards mandated under the Energy Policy and Conservation Act of 1975 and the performance standards required by the Energy Conservation and Production Act of 1976 should be made equivalent. The NOPR recognizes this need. However, DOE has taken the particularly sanguine view that prescriptive standards should be made more strict to conform with the Proposed Rule. In so doing, DOE has told the 38 states which have seen fit to adopt ASHRAE 90-75 in response to the Energy Policy and Conservation Act to "go back to the drawing board." Such an about-face in Federal policy only adds to the confusion and uncertainty inherent in planning and building any new structure. NRMA believes that Federal prescriptive codes and performance codes should be merged so that builders have the option of complying with either the prescriptive or performance elements on one uniform standard.

The NOPR Budgets are Based on Faulty Assumptions

The budgets also cannot be justifed on an economic or statistical basis.

The data base upon which the NOPR budgets are based is too small and too biased for DOE to draw any meaningful conclusions about the way retail buildings look and the way they operate. For instance, Phase I data base for retailing consists of only 176 buildings with a substantial range of energy use which runs from a minimum of 25 MBTU/sq. ft./yr. to a maximum of 230 MBTU/sq. ft./yr. The standards themselves are based on only a handful of data points -- the 20 Phase II building redesigns -- extrapolated for both free standing stores and shopping centers.

In addition, the Phase I data were not drawn using true random sampling techniques. Instead, they were drawn exclusively from 37 large Standard Metropolitan Statistical Areas (SMSAs), thereby introducing bias by ignoring a significant number of suburban and small town buildings. Further, 45 percent of the original number surveyed refused to provide information, also introducing bias. DOE further compounded this problem by drawing Phase II data exclusively from the Phase I universe, but only where designers agreed to participate, adding yet a further source of bias. Moreover, the building redesigns were only "paper exercises." NRMA does not believe, therefore, that the building redesigns adequately addressed merchandising concerns.

Similarly, in the Technical Support Document entitled "Economic Analysis," DOE has claimed that stringent standards are more beneficial than lenient standards for both the nation and for individual building owners. For mercantile buildings, this claim is based on a complex life cycle costing (LCC) analysis that calculates net present values (NPVs) of 1.26 and 1.58 for retail investments in increased conservation. On its face, a return of $1.58 per square foot on conservation investments to meet the standards appears quite attractive. However, there are several seriously flawed assumptions in DOE's analysis, any one of which could eliminate this return and actually make it negative.

For instance, the time frame used in DOE's life cycle costing analysis was thirty years -- a reasonable life for the building, but not for HVAC equipment or for lighting systems -- both of which have shorter useful lives. For HVAC systems, useful lives run about fifteen years. As a result, a thirty-year life cycle costing analysis would have to figure the cost of HVAC systems twice. Lighting systems in retail buildings also pose a unique problem because of merchandising concerns. Hence, useful lives are very short for these systems, and must be figured several times in any LCC analysis. Yet, DOE does not appear to have figured the costs of these investments in its analysis.

DOE also failed to recognize the important relationship between reduced lighting levels and sales in retail establishments. Retailers are experts in merchandising, and it is a simple fact of life that well lit merchandise sells better than poorly lit merchandise. The BEPS standard will force retailing to change the way merchandise is lit. The standard could actually force retailing to reduce by half or more the amount of lighting in new mercantile buildings. In our expert opinion, such a reduction will have enormous sales impact. One NRMA member estimates that even a small decline in sales, say one percent for a 100,000 sq. ft. store, could translate into a $1.00 per sq. ft. loss virtually wiping out the NPV calculated by DOE.

NRMA believes DOE has also underestimated the additional construction and design costs that the standard will require. DOE claims that the added cost per square foot of complying with the standards is $1.06. On the other hand, one NRMA member has estimated the costs to be on the order of from $3 to $6 per square foot.

Any one of these items -- failing to include the costs of replacing major systems, lost sales, or greater construction costs -- can significantly reduce or even eliminate the positive NPVs DOE has calculated. Taken together, there is no question that the NOPR budgets are economically unjustified for retailers.

The Weighting Factors are Unnecessary

In addition to its primary goal of improving building efficiency, the Energy Conservation and Production Act contains a secondary purpose -- to discourage the use of nonrenewable energy sources. DOE considered three alternatives to achieve this end: Resource Utilization Factors (RUFs) and Resource Impact Factors (RIFs), Weighting Factors based on the "relative value of different nonrenewable fuels to the nation expressed in terms of fuel prices and explicit national policy determination of non-market values associated with specific fuel types," and reliance on market forces to signal "values."

The ANOPR suggested the use of RUFs and RIFs, which were dropped by DOE in lieu of Weighting Factors based on DOE's 1985 energy price projections with a premium added to oil and natural gas to reflect the extra "value" to the nation of saving these fuels.

NRMA disagrees with DOE's final choice among the alternatives considered. Retailing has consistently taken the position that the only appropriate way to signal the "value" of a resource is through the pricing system. We have consistently advocated pricing energy sources based on the cost of supplying them.

Accordingly, we opposed the RUFs and RIFs approach of the ANOPR, and we are equally opposed to the Weighting Factors included in the NOPR.

We have three concerns with the Weighting Factors. First, they are based on a faulty assumption of how investment decisions are made. Second, they "lock-in" a set of value judgments which are subject to substantial change. Finally, they fail to recognize significant regional and local variations in the value of energy resources.

In Technical Support Document #4, "Weighting Factors," DOE sets forth a rationale for the use of Weighting Factors in lieu of market forces which is invalid. On page 13 of the document, DOE develops a hypothetical case which is supposed to show why "value based" Weighting Factors are needed, and why market forces do not provide designers with the correct signals with respect to nonrenewable fuels. But DOE's argument only works if the notion of "first cost minimization" is accepted without question. Yet, virtually all builders of commercial facilities look farther than first costs. Why? Because it is economical to do so.

Table II, "Conservation Investment Analysis," illustrates just how costly reliance on first costs alone would be for the developer. The first two columns represent the hypothetical case DOE has postulated, where the designer looks at the Investment Cost/MBTU and chooses natural gas over electricity because on a first-cost basis natural gas conservation is half as expensive as electric conservation.

TABLE II

CONSERVATION INVESTMENT ANALYSIS

	Price/ MBTU	Investment Cost/ MBTU	Payback Ratio	Useful Life	12 year		
					Cost	DCF*	NPV
Natural Gas	$ 5	$ 10	2.0	3 yrs.	$ 40	1.34	8.71
Electricity	$ 10	$ 20	1.3	12 yrs.	$ 20	5.18	83.65

* 10 Percent Discount Rate

However, Column III shows how blind acceptance of first cost minimization could result in a designer making investments in gas conservation with only one half the payback of investment in electric conservation. Columns III and IV illustrate how investing in natural gas conservation would actually be twice as expensive, over a twelve-year basis, as investments in electricity. What's more, the return on the investment in electricity is five times greater than the return on the gas investment. Clearly, with large investments of capital involved, builders and developers are going to look at NPVs and discounted cash flow analyses before committing their money. To assume otherwise, as DOE has done, is incorrect and naive.

Thus, a life cycle costing methodology, whether explicit or implied, is in fact used by commercial developers. Under such conditions, owners will make decisions based on the relative prices (both current and projected) of the fuels to be saved, the relative effectiveness of alternative technologies, and the relative size of the necessary capital investments. The result will be conservation efforts which balance these various factors in achieving the best long run result.

The proposed Weighting Factors also establish a current view of the "relative value" of energy resources. As our energy history has more than amply demonstrated, however, the "value" of these resources to the nation and to individuals is subject to substantial change over relatively short periods of time. These changes in "value" are reflected in changing prices. To lock a given set of "values" into the BEPS eliminates the flexibility a building owner ought to have to properly respond as these "values" change. We are all familiar with the perverse effects that control of gas and oil prices have had on our society. To create a similar impediment to our ability to respond to changing circumstances would be foolish and potentially dangerous.

Of equal importance, DOE has chosen to base its "shadow pricing system" on the Energy Information Agency Midrange Energy Forecasting System (MEFS) forecasts for 1985. These forecasts have been notoriously bad, and have changed almost from moment to moment. For instance, in 1978 DOE projected that the price of a barrel of Residual Oil in 1985 would be $24.00. In 1979 they revised that estimate to $27.86. But today, in 1980 we are already paying over $30.00 for the same resource. In addition, DOE has added a premium of $1.29 per million BTU to oil and gas prices, which reflects the additional "value" to the nation of saving these fuels. Yet the Weighting Factors will not lead to the conservation of these resources. They will, in fact, result in additional, uneconomic consumption of natural gas.

Table III, "Weighting Factors Impact, illustrates just how severe the electricity penalty is with respect to retail buildings. The information displayed in the table was provided by an NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores currently in design. All figures are based on interpretations of the results of computer designs using EST-I programs, and DOE's SBOC and climate input data.

The chart displays the performance of the stores when certain specific conservation measures are taken. The first row ("NOPR") shows the BEPS standards for reference. Row two ("ASHRAE") illustrates the performance of the stores when built to ASHRAE 90-75 standards and using 2.5 wts./sq. ft. of lighting. Row three illustrates what would happen if lights were then reduced to 1.9 wts./sq. ft. Row four displays the buildings' performance if gas conversion was undertaken wherever possible. Finally, rows five and six indicate the budget reductions possible if lighting was further reduced and if changes were made in the roofs of the buildings.

Table III illustrates two important retail concerns. First it directly refutes DOE's claim[3] that the Weighting Factors will not affect buildings able to comply with unweighted budgets. Second, Table III indicates that the Weighting Factors actually encourage the consumption of natural gas wherever possible.

The analysis indicates that the store built in the South and designed to use no more than 1.55 wts./sq. ft. of lighting would comply with the unweighted budget but not with the weighted budget. Even more troubling, if natural gas was not available, a store built in the North would be in the same situation and would still not comply with the weighted budget even if its lighting were further reduced to 1.14 wts./sq. ft.

The magnitude of the change required in lighting levels over current practice is staggering. Most retail stores are not even achieving the 2.5 wts./sq. ft./yr. which an "ASHRAE-equivalent" standard would require. (Most retailers are consuming about 3 wts./sq. ft.) In order to comply with the proposed BEPS, retailers would have to reduce lighting consumption to less than 1.55 wts./sq. ft. -- a reduction of more than half. As discussed above, the effect this would have on sales would be enormous. Moreover, if natural gas is unavailable, it is highly likely that many new retail buildings simply would not be built.

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[3] Notice of Proposed Rulemaking, Energy Performance Standards for New Buildings, November 1979, page 2-39.

TABLE III**

WEIGHTING FACTOR IMPACT

	NORTH		SOUTH	
	Weighted	Unweighted	Weighted	Unweighted
NOPR	158	65	169	58
ASHRAE (L'ts 2.5 wt/sq. ft.)	230	75	205	67
Lights (1.9 wt/sq. ft.)	223	73	191	62
Gas Conversion	171	73	187	62
Lights (1.55 wt/sq. ft.) and Roof	200*/157	64	176	58
Lights (1.14 wt/sq. ft.) and Roof	189*/146	61	166	55

*Natural Gas is not available
Figures expressed in MBTU/sq. ft./yr.

** Information provided by one NRMA member undertaking an analysis on two 100,000 sq. ft. stores currently in design. Numbers are based on interpretations of results of computer models using EST-I programs and DOE's Standard Building Operating Conditions and climate input data.

The table demonstrates quite clearly that in order to comply with weighted budgets, natural gas must be used wherever possible. The Weighting Factors, therefore, actually encourage the use of a "valuable" nonrenewable resource, and discourage the use of energy which may come from hydroelectric, nuclear, or coal-fired utilities.

The vast variety of tastes, locations, and utility systems in this country requires that the BEPS take cognizance of local or regional variations in energy resources. These variations in sources and supply are expressed most readily by variations in energy prices. Rational decision makers respond to these price differentials by designing buildings to meet local conditions. As shown above, the proposed Weighting Factors totally ignore these regional variations. Instead, they force all building owners to respond to a single set of conditions. The result of this approach is clearly damaging for retailing.

In conclusion, NRMA believes that the Weighting Factors are invalid. We, therefore, urge DOE to drop the Weighting Factors from the BEPS standard.

Process Energy is Inadequately Defined

BEPS includes energy used for heating, cooling, domestic hot water, ventilation, exhaust fans and vertical transportation. Energy used for process, equipment and appliances does not appear to be included. Retailing has two concerns with this definition of "process energy."

First, this definition does not adequately recognize the importance display lighting plays in retail establishments. The lighting levels in retail stores are directly related to retail sales. As indicated above, the proposed BEPS coupled with the Weighting Factors would force retailing to significantly reduce lighting levels -- by half or more from current practice -- in new stores. Even if the sales losses were modest -- one percent for instance -- all of the benefits achieved through increased efficiency and reduced operating costs would be lost. There is every reason to believe, however, that the drastic reductions in lighting required by the standard will have much more than "modest" sales effects.

Accordingly, we believe a certain amount of retail lighting should be exempted as process energy. There is a precedent for viewing display lighting differently from regular lighting -- DOE has already made this distinction in its recently published Standby Federal Conservation Plan.[4]

NRMA is also concerned that the definition of process energy does not include store beauty salons, restaurants and automotive repair operations. Clearly, these retail functions should not be included when figuring retail energy budgets. If DOE does intend to include these energy uses, retailers would have no other choice but to consider dropping some or all of these services from store plans and be faced with the attendant economic losses.

The intention of the BEPS program is to improve the efficiency of buildings at a faster rate than would be achieved by market forces alone. However, the BEPS programs outlined in the NOPR goes far beyond this intention. Because the budgets represent a significant break with past and present trends, because the Weighting Factors heavily penalize the use of electricity, and because DOE has failed to recognize the relationship between retailing's use of lighting and sales, the NOPR carries the potential of disrupting the "modus operandi" of all retailers. The proposed BEPS will drastically affect our operations and ultimately the kind of business we do, and in many cases will "force" retailers to reduce future construction, in addition to requiring more efficient buildings.

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[4] 45 Federal Register 8490 (February 7, 1980)

II. SANCTIONS

The Energy Conservation and Production Act includes a sanction which NRMA believes is draconian. The statute requires that no Federal financial assistance may be provided in states or localities that fail to adopt the BEPS program. "Federal financial assistance" is defined to include not only "any form of loan, grant, guarantee, insurance, payment, rebate, subsidy, or any other form of direct or indirect Federal assistance (other than general or special revenue sharing or formula grants made to states)" but also "any loan made or purchased by any bank, savings and loan association, or similar institution subject to regulation by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, or the National Credit Union Administration."

Although only a minority of retail construction projects receive direct or indirect Federal financial assistance, virtually all depend on funding from the second category of sources. The sanction virtually guarantees that all construction would be halted in an affected state or locality. This would happen regardless of whether retailers, the construction industry, and others agreed to comply with the code in the absence of local adoption of it. Thus, the sanction would be imposed on people and business firms who are not able to take the actions necessary to avoid its imposition. While the statute provides for the possibility that the sanction would not be imposed in a state or locality which had failed to adopt the standards (or their equivalent), the alternative depends on the ability (legal and technical) and willingness of a state or local governmental agency to enforce the standards. This seems likely to be useful in only very limited circumstances, i.e., where a state or local government is in the process of enacting the standards but has not done so by the deadline for imposition of the sanctions. Where there has been an affirmative decision not to adopt the standards, an agency is very unlikely to be in a position, legally or practically, to reverse that decision by enforcing the standards under this Federal statutory provision. For the reasons discussed elsewhere in this statement, NRMA believes that many state and local governments will decide not to adopt the program if it remains as now proposed. Thus, we are very concerned that construction would be halted in many areas of the country, whether or not new buildings would actually comply with the standards.

NRMA believes this is unfair. We urge DOE and the Congress to develop a substitute sanction aimed at those who do have the ability to take the necessary actions, and would allow individuals to comply even if a state or locality refused to adopt or enforce the standard.

III. IMPLEMENTATION AND COMPLIANCE

Public Law 94-385 required DOE to develop a Standard Evaluation Technique (SET) to determine whether a specific building design complies with the design energy budgets. The SET is composed of three major elements: an energy calculation method (DOE-II, TRNSYS and DEROB); fixed parameters, such as weather data and Standard Building Operating Conditions (SBOCs) which fix a consistent basis for establishing compliance; and procedures for combining the calculation method with the fixed parameters.

NRMA recognizes the need for establishing a "yardstick" by which to measure compliance. However, we are deeply troubled, as long-time supporters of performance standards, by the complexity of the approach DOE has taken. The SET will undoubtedly lead to misunderstandings, timing difficulties, and a host of essentially technical problems which could doom BEPS from its very inception.

Such a failure of performance-based standards would undoubtedly suggest to Congress and state and local officials that performance standards should be discouraged and prescriptive standards encouraged. This would lead to even greater governmental interference in the design and construction industries, distorting the market and achieving lower levels of energy efficiency.

NRMA has three concerns with regard to the SET. First, the energy calculation method -- the DOE-II program -- is largely untried, and not clearly tied to budgets themselves. Second, because of the size of the data base and problems with the statistical method, the SBOCs are not always representative of the way retail buildlings operate. Third, because process energy is not included and because DOE has chosen a "yardstick approach," the SET will not always predict actual building energy consumption.

DOE has proposed using the computer program, DOE-II, as the principal calculation method of the SET. The most important problem with this approach is that the budgets themselves were developed using a different computer model -- the proprietary AXCESS computer program -- and no study has been made to see how well DOE-II relates to AXCESS. This is especially problematical in light of the apparent difficiencies in the AXCESS program. Because this proprietary program is largely inaccessible, NRMA is unable to comment in-depth on its faults. However, it is common knowledge that the program is incapable of evaluating energy management controls, heat pumps or pipe and duct insulation.

Moreover, DOE-II, based in large part on CAL-ERDA, is untested. It has been used in only a handful of instances to actually analyze new building designs. Its efficacy in predicting energy use for complex designs such as shopping centers is, therefore, unknown. In this light, NRMA believes the program will have to be thoroughly "debugged" before it is ready for use on a daily basis.

As discussed earlier in these comments, serious difficiencies exist in both the Phase I and Phase II data. Yet, these data were used to calculate SBOCs. Obviously, these conditions cannot possibly fit all retail buildings. NRMA is unable to determine if faulty SBOCs will significantly help, or hurt, retailers generally. At least one NRMA member has indicated that SBOCs will cause design changes which will actually increase energy consumption. SBOCs will certainly assure that "design" energy consumption will bear little or no relationship to "actual" energy consumption.

Accordingly, any use of the numbers generated by the SET to review compliance with the program by measuring in-use consumption of buildings designed in compliance with the standards would be disastrous. Retail buildings which comply with the design consumption levels in the standards when compliance is measured using the SBOCs and DOE-II with process energy uses excluded may in actual operation consume significantly more energy than the design levels. So long as everyone understands that the design budgets are fictions based on assumptions and estimation techniques, the program could succeed -- and would, in all probability, achieve energy savings over the status quo. DOE must make this point absolutely clear to enforcing authorities and the general public.

To the extent that DOE fails to make this fiction universally understood, however, there would be a natural inclination by someone wanting to measure the "in-use" success of the program to compare actual consumption levels with the design levels. Such a measurement would suggest that buildings were being constructed in violation of the standards -- of great potential embarrassment to builders and enforcement officials. Similarly, anyone wishing to develop standards for consumption levels of existing buildings would naturally begin with the levels already set for new buildings. Even if modifications to the BEPS levels were made to accommodate the fact that these buildings were designed and constructed when energy was plentiful, the resultant standards would be far out of the range of what would be achievable.

In addition to this concern, NRMA believes that the design and construction professions and the state and local enforcement officials will require a minimum of six months to one year simply to understand the BEPS program -- the budgets themselves as well as the SET. Since no governmental body should be required to adopt and enforce a program which even its most sophisticated personnel do not yet understand, NRMA suggests that DOE, with the concurrence of Congress if necessary, extend the time period for adoption of the standards by state and local government to a minimum of eighteen months to two years after the promulgation of the final Federal regulations. Further, NRMA believes that DOE should provide an extensive program to educate both public and private sector officials about the program and its technical bases.

Because of the need to expand the initial implementation time period, NRMA urges DOE to refrain for at least three to four years from making significant revisions which would either change the way in which the standards are measured or impose more burdensome design consumption levels. Even changes which are supposed to simplify the program should be carefully scrutinized to ensure that they really will do so and that the benefits to be derived from the changes outweigh the costs of re-educating those who will have to live with them. Moreover, any changes made in the standard ought to be tied to changes in the ASHRAE 90-75 program.

Even when the standards are adopted for use by state and local building code authorities, buildings which have already entered the specification phase of design should be exempted from the program. The expense involved in redesigning and changing equipment which may already have been ordered is too great for buildings which have already advanced in the design process. Alternatively, NRMA suggests that buildings not be required to comply with the standards until a set time, perhaps two years after their adoption by the state and local governments. This would accomplish the same purpose without requiring enforcement officials to check company records to determine precisely when specifications were set. Most large retail construction projects are designed two to three years before the facility is open during which it becomes increasingly costly to make significant changes.

IV. RECOMMENDATIONS

The NOPR published at 44 Federal Register 68119 (November 28, 1979) poses many problems to retailing -- the energy budgets represent a major shift from current trends; the Weighting Factors are unneeded and severely penalize the use of electricity; the Sanction included in the Statute is draconian and poorly directed; and the SET is too complex and largely untested in the "real world."

Nonetheless, retailing continues to favor performance standards. We strongly believe that the BEPS program can work. To make it work, however, we believe several changes must be made in the NOPR.

First, DOE should seek to develop design budgets which are equivalent to performance achievable under ASHRAE 90-75. Such a standard will serve the intended purpose of the building code envisioned by Congress -- namely to realize greater energy savings than would occur by reliance on market forces alone. A performance standard comparable to the prescriptive ASHRAE 90-75 standard would be even more stringent than the energy budgets originally proposed by DOE in the 1978 Advance Notice, and it would be achievable.

NRMA opposes Weighting Factors of all types including RUFs and RIFs. Instead, we believe that all budgets should be evaluated in terms of building boundary consumption. NRMA does not believe that the Weighting Factors can be made acceptable through any changes and we recommend they be dropped from the Final Rule.

NRMA also urges DOE to clarify the definition of process energy to exempt beauty salons, automotive repair services, restaurants and display lighting from the design consumption of retail buildings.

NRMA urges DOE and Congress to develop a substitute sanction which permits individuals to be found in compliance regardless of what a state or locality may have done.

NRMA urges DOE to extend the time period for states and local governments to adopt the standards to a minimum of eighteen months to two years after promulgation.

NRMA believes that DOE should provide an extensive program to educate both public and private sector officials about BEPS.

Finally, NRMA urges DOE to refrain from making significant revisions in the BEPS program for at least three to four years and tie such revisions to changes made in the ASHRAE 90-75 standard

Senator **Durkin**. Mr. Endahl.

STATEMENT OF LOWELL J. ENDAHL, COORDINATOR, RESEARCH AND TECHNOLOGICAL DEVELOPMENT, NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

Mr. **Endahl**. Mr. Chairman, my name is Lowell Endahl. I am coordinator of research and technological development for the National Rural Electric Cooperative Association and have with me Mr. John Meshaw who heads up our energy conservation efforts within NRECA.

We appreciate the opportunity to present the NRECA views with respect to the residential aspects of the proposed building energy performance standards.

I will try to make these comments very brief.

NRECA is a national service organization for some 1,000 rural electric cooperatives over the country, serving approximately 25 million people in 46 States.

The electric cooperatives, at their annual meeting in March of this last year, adopted a resolution. At that meeting, some 11,000 people were present to adopt the resolution on building energy performance standards.

Basically, that resolution states that the rural electrics support the need for stringent standards of energy-efficient buildings, as mandated by Congress, but they feel that the Department of Energy has severely distorted the intent of the legislation by incorporating weighting factors and considerations other than efficiencies in new buildings.

As you know, the rural electrics have been fighting the battle for more efficient residential buildings for more than 25 years, attempting to help members reinsulate and retrofit their buildings so that they can use electricity efficiently and effectively.

As a result, the electric-heated homes in the areas that we are serving generally are fairly efficient.

Now, as you know, the rural electric cooperatives and utilities, in general, are required to conduct energy audits and assist consumers to improve the energy efficiency of their homes that have been built to be heated by oil and gas.

Now, we think the energy audits are a good idea. But in most of the areas of the country, we think that this probably is not going to reduce electric consumption very much.

We are faced now with a proposed building energy standard and, because of the weighting factors concept and life cycle costing approach, it will permit a builder to build less efficient houses if oil or gas is to be used as the fuel.

Those houses will probably be in place 50 years from now. We need to ask ourselves this question: What is going to be the fuel situation in 15 to 20 years and on down the road? Will they still be competitive in cost or will they still be available at all?

We believe that consumers must have the option of selecting their energy source on the basis of economics and availability and we believe that they have a right to have homes built to stringent enough standards so that they are in a position to use the best available source of energy.

We would like to see all homes built to such standards of efficiency, that they could be converted easily to solar heating or electricity, solar heating as that technology is developed and becomes more economical.

Construction of buildings at anything less than maximum practicable thermal efficiency will forever negate that option.

That is our major concern. And, Mr. Chairman, we just don't want to have to go through that procedure again.

We see several other major problems in connection with the proposed BEPS, and those are outlined in the statement.

I will just touch on them briefly.

The proposed standard, with its weighting factors and life cycle costing approaches and the considerations other than efficiency in new buildings, we believe, goes far beyond the intent of the legislation.

And the focus of that legislation was to reduce wasteful end use of energy in new buildings; nothing more and nothing less.

The standard works against the need to develop and use coal, our most abundant source of energy, in a way that can reduce our need for imported oil.

The standard is far too complex. We believe that the proposed standard will be extremely difficult and costly to implement and enforce. Many millions of dollars have already been spent in the development of the standards and untold millions more, including an expanded Federal and State bureaucracy, will be required to implement it. And consumers are going to have to pay that bill.

These standards, we believe, effectively eliminate the opportunity for a consumer to substitute solar or electricity for imported fuels as energy for space conditioning should those fuels become too costly or unavailable.

The proposed standard includes a complex energy budget approach that also involves the usage of appliances and equipment.

The standards for residential building should concern themselves with only the building envelope and not the appliances, including water heaters, within the buildings since all of those are subject to change.

Now, we suggest a better approach, and I am happy to hear that it has already been suggested. We urge that the new standards be at least as stringent as those developed and in use by the Farmers Home Administration, the U.S. Department of Agriculture.

In fact, we suggest that it would be a simple matter to determine the thermal performance of residential buildings constructed according to these standards and that the new building energy performance standard could simply require this thermal performance as a minimum.

This approach would provide both a prescriptive and the performance standards that appear to be so necessary for early implementation and success in achieving energy efficient building.

The Farmers Home Administration's standards are already in place, and they are proved. Such an approach would provide an easily understood, simple, acceptable substitute for the unbelievably complex DOE-proposed building energy performance standards.

It would give complete freedom to owners, builders, designers in selecting desired techniques to attain energy efficiency, as well as the space conditioning systems and energy sources which they prefer.

And we would depend on the minimum appliance efficiency standards currently being developed by DOE to make certain that the systems and the equipment for those single-family residences be energy efficient.

In summary, we want to reaffirm our support for stringent thermal efficiency standards in buildings, with special emphasis on residential buildings.

We want to see fair, appropriate, simplified standards instituted as soon as possible.

But the NRECA membership has expressed its concern that the DOE-proposed BEPS is discriminatory, far too complex, and may be too lenient. And we cannot support BEPS as proposed until some changes are made and until we learn the plans for implementation.

Thank you, Mr. Chairman.

Senator **Durkin**. Thank you.

[The prepared statement of Mr. Endahl follows:]

STATEMENT OF
NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION
BEFORE THE
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
ON
PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

JUNE 26, 1980

Mr. Chairman and Members of the Subcommittee: My name is Lowell J. Endahl, Coordinator of Research and Technological Development for the National Rural Electric Cooperative Association (NRECA). We appreciate the opportunity to present the NRECA membership views with respect to the proposed Building Energy Performance Standards.

NRECA is the national service organization which represents nearly 1000 non-profit, consumer-owned rural electric systems which provide electric service to approximately 25 million people in the rural and sparsely populated agricultural areas of 46 states. These small cooperatively-owned electric systems are located in 2,600 of the nation's 3,100 counties and operate more than 40% of the distribution line in the nation to serve about 9% of the population, which has a high ratio of the nation's low income families.

The rural electric cooperatives at their annual meeting in New Orleans, March 3-6, attended by nearly 11,000 people, adopted a series of resolutions which reflect the grass roots views on the issues. One of these resolutions spoke directly to their views on the proposed Building Energy Performance Standards. A copy of the resolution is attached to this statement.

The resolution begins by stating "Rural electric cooperatives support the need for stringent standards for energy efficient buildings as mandated by Congress in the Energy Conservation Standards for New Buildings Act of 1976." Indeed, rural electric systems have been fighting the battle for more efficient residential buildings for at least 25 years. They have been leaders in encouraging higher residential standards for insulation, and in finding ways to retrofit and reinsulate old buildings for thermal efficiency. They know first hand, the problems and the cost of trying to recondition houses (some of them relatively new) to bring them up to their standards for thermal efficiency. In their view, it makes no sense at all to build a new home without making it as energy efficient as possible, without regard for the heating fuel to be used.

Most members of rural electric cooperatives live out beyond the natural gas mains, and do not have access to natural gas. Under the proposed BEPS, however, a builder could build a less thermal efficient (and somewhat less costly) house with the understanding that it was to be heated by fuel oil or propane (a derivative of crude petroleum). Thus it is easy to see why the proposed BEPS (with its weighting factors and life cycle costing approaches) is encouraging the use of imported fuels when the nation's goal is to reduce this consumption. If this fuel is no longer available, the consumer has no choice but to try to heat his home with electricity or solar energy. But this might not be practical since the house is not well insulated, and it will be difficult, if not impossible to bring it up to proper thermal efficiency standards.

The proposed BEPS seems to be aimed at eliminating electricity and even solar energy as a future source for residential space conditioning. Actually it is in the national interest to use both, since they result in decreased use of imported oil. Most of the electricity generated by rural electric cooperatives is from coal fired power plants. Coal by wire makes a lot of sense since it permits the use of our most abundant form of energy.

Rural electric systems are opposed to any discriminatory building energy standards approach which permits a builder to construct a building with less thermal efficiency if oil or gas is used as a fuel. Such a building standard obviously is contrary to national energy policy and dilutes efforts to promote energy conservation. Furthermore, and perhaps even more important, consumers suffer from this relaxed standard by having to pay higher heating and cooling bills. Costs of energy, of all types, can be expected to continue to rise at an excessive rate. Consumers must have the option of selecting their energy source on the basis of economics and availability, and be in a position to switch if necessary. Constructing buildings at something less than the maximum practicable thermal efficiency, will forever negate that option.

Buildings constructed today might still be in use a century from now. Yet there is no assurance that this nation will have oil and gas supplies available to it for the purpose of space conditioning--even twenty years from now. What happens then? We hope that all buildings can be built to such efficient standards that they could be converted easily to solar heating. In any case we urge that every building be constructed to make use of passive solar energy to the extent possible.

Major Problems with BEPS

We see the following major problems in connection with the proposed BEPS:

- The proposed standard with its "weighting factors" and considerations other than efficiencies in new buildings goes far beyond the intent of Congress by attempting to dictate preferred fuel usage. Focus of the legislation was to reduce wasteful end-use of energy in new buildings--nothing more, nothing less.

. The proposed standard is discriminatory against electricity and our abundant coal reserves and will result in greater use of imported fuels, and is therefore directly contradictory to national energy policy.

. The proposed standard is discriminatory in that it relaxes the standards for oil and gas and permits the construction of houses that are less energy efficient if those fuels are used.

. The proposed standard is extremely complex to the point that it will require the use of computers and sophisticated techniques for building design, and will thereby effectively rule out the opportunities for innovation by the small contractor, who will probably use the same "approved" design over and over again.

. The proposed standard will be extremely difficult and costly to implement and enforce. Many millions of dollars have already been spent in the development of the standards and untold millions more (including an expanded Federal and state bureaucracy) will be required to implement them--and the consumer will have to pay the bill.

. The proposed standard does not lend itself to opportunities for innovative space conditioning devices and load management (i.e. the use of dual fuel--electricity and oil--heating systems).

. The proposed standard effectively eliminates the opportunity for a consumer to substitute solar or electricity for imported fuels as an energy for space conditioning, should those fuels become too costly or unavailable.

. The proposed standard includes a complex energy budget approach that also involves energy usage of appliances and equipment. The standard for residential buildings should concern itself with only the building envelope--not the appliances (including water heaters) within the building since they are subject to change.

An Alternative Approach

We respectfully suggest that a better approach--one that would implement the clear intent of Congress--would be to eliminate the weighting factor concept altogether and use instead an Annual Design Budget expressed in Btu/ft^2/yr. A single number (not dependent upon types of fuel or energy used) would be provided for each class of building in each climatic zone, and this number should be established at the maximum practicable level of insulation and glazing consistent with national energy policy and economic concerns. It should not include energy uses for appliances and equipment or domestic water heaters. This will help assure that the building envelope is designed to attain maximum practicable efficiency throughout its useful life regardless of the space conditioning equipment or domestic hot water systems installed initially or retrofitted. This approach will also encourage use of passive solar techniques, and eventual retrofitting with active solar systems as the technology is developed and becomes more economical.

We urge that the new standards be at least as stringent as those developed, and in use, by the Farmers Home Administration of the U.S. Department of Agriculture. In fact we suggest that it would be a simple matter to determine the thermal performance of residential buildings constructed according to these standards; and that the new Building Energy Performance Standard could simply require this thermal performance as a minimum. This approach would provide both the prescriptive and performance standards that appear to be so necessary for early implementation and success in achieving energy efficient buildings. The Farmers Home Administration standards are already in place and have been proven over the past two years. Such an approach would provide an easily understood, acceptable substitute for the unbelievably complex DOE proposed BEPS. It would give complete freedom to owners, builders and designers in selecting desired techniques to attain energy efficiency, as well as the space conditioning systems and energy sources which they prefer. The systems and equipment selected for single-family residences should be energy efficient by virtue of the minimum appliance efficiency standards currently being developed by DOE.

In summary, we want to reaffirm our support for stringent thermal efficiency standards in buildings, with special emphasis on residential buildings. We want to see fair, appropriate standards instituted as quickly as possible. But the NRECA membership has expressed its concern that the DOE proposed BEPS is discriminatory, far too complex, and may be too lenient, and we cannot support BEPS as proposed.

SUBJECT: Proposed Revision of Building Energy Standards

Rural electric cooperatives support the need for stringent standards for energy efficient buildings as mandated by Congress in the Energy Conservation Standards for New Buildings Act of 1976 (Title III, PL 94-385).

We feel, however, that the Department of Energy (DOE) has severely distorted the intent of the legislation in its proposed Building Energy Performance Standards (BEPS) by incorporating "weighting factors" and considerations other than efficiencies in new buildings.

Specifically, the proposed BEPS attempts to account in part for energy losses occurring at electric powerplants, oil refineries and gas-processing plants, and in part for the "social costs" of the use of various forms of energy. Weighting factors create a three-to-one preference against the use of electricity that will effectively dictate the use of oil or natural gas wherever there is a choice to be made.

Furthermore, under the proposed BEPS, building designers would be permitted to design a less efficient building if the fuel to be used is natural gas or oil; and we feel this is contrary to national energy policy and dilutes efforts to promote energy conservation.

A better approach, one that will implement the clear intent of Congress would be to base energy budgets on annual space heating and cooling loads, all expressed in BTU/ft.^{2} A single number should be provided, one not dependent on fuel and energy use but established at the maximum practicable level of insulation and glazing consistent with national energy policy and economic concerns. This will help assure that the building envelope is designed to attain maximum practicable efficiency throughout its useful life, and so also will encourage use of passive solar techniques, something which is not specifically encouraged through BEPS as now proposed.

This approach also will give complete freedom to owners, builders and designers in selecting the techniques to attain energy efficiency as well as the systems and energy sources which they prefer. The systems and equipment selected in single-family residences will be energy efficient by virtue of the minimum appliance efficiency standards being developed by DOE. This standard easily can be expanded to encompass the systems and equipment commonly found in commercial buildings.

Senator **Durkin**. Has anyone done any work on what the difference in projected energy savings would be by adopting as an interim the Farmers Home provision as opposed to BEPS as it is now drafted?

Are there any figures on that?

Mr. **Endahl**. We have not conducted that kind of a study, but we have had a good bit of experience with the Farmers Home Administration standards.

We believe they are the best standards that we have seen in terms of energy conservation, energy efficiency.

And we believe that this would be a good starting point for at least some guidelines to be used for thermal performance.

Mr. **Turnbull**. Senator, attached to my testimony was a table which was developed by NRMA—one of NRMA's members for comments on BEPS.

And that table shows, for a 100,000-square-foot retail store, one in the North and one in the South, the consumption levels both from the—or, from a number of different perspectives, from the phase I data that DOE developed, from the advanced notice of proposed rulemaking in November 1978, from the current design—at least, as far as this one NRMA member was concerned—and then the ASHRAE equivalent which was our recommendation, which is the corresponding standard for the FmHA, only this for commercial buildings, and for the notice of proposed rulemaking, BEPS.

And what you will see on that table is that the ASHRAE equivalent is between the current design situation and the notice of proposed rulemaking by DOE.

Mr. **Kimpflen**. Senator, we looked at what we believed to be the current average levels. And using a ranch home of 1,500 square feet in three different cities, we compiled what we believed would be the savings in an individual home in St. Louis, Minneapolis, and Dallas.

It is our projection that the change in thermal performance levels in St. Louis would amount to about $170 a year, with oil prices at $1 a gallon.

In Minneapolis, it would be over $260 and, in Dallas, because of the dramatic change in requirements, it would be about $240.

I have got these numbers if you would wish to have your staff have them.

Senator **Durkin**. We could probably put those in the record if we don't have them already.

[The requested material follows:]

Ben Al

United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, D.C. 20510

July 10, 1980

Mr. Joseph Kimpflen
MINERAL INSULATION MANUFACTURERS ASSOCIATION
382 Springfield Avenue
Summit, New Jersey 07901

Dear Mr. Kimpflen:

Pursuant to the hearing before the Subcommittee on Energy Regulation on June 26, 1980, on the Department of Energy's BEPS program, we attach a portion of the transcript of your testimony on that date wherein you stated that you would be able to send certain data in response to Senator Durkin's question.

Your assistance in providing this information directly to Benjamin S. Cooper of the subcommittee staff at 3106 Dirksen Senate Office Building, Washington, D. C. 20510, by July 25, 1980, will be greatly appreciated. Any inquiry about this request can be referred to him at (202) 224-9894.

Thank you.

Sincerely yours,

J. Bennett Johnston
Chairman, Subcommittee on
Energy Regulation

JBJ:bcg

Ba

mima
Mineral Insulation Manufacturers Association
382 Springfield Avenue,
Summit, N.J 07901
(201) 277-1550

July 21, 1980

United States Senate
Committee on Energy and Natural Resources
Washington, D.C. 20510

ATTN: Mr. Benjamin S. Cooper

Gentlemen:

In response to Senator Johnston's letter of July 10, 1980, I have enclosed the data referred to in my testimony presented on June 26, 1980.

The data indicates the energy savings which could occur if current widely used practices for thermal insulation in new construction were increased to those required in the new construction standards of the Farmer's Home Administration. The calculations are based on the change in heat loss (U_2-U_1) with the change in insulation levels. The specific energy cost savings are related to the degree days for the cities chosen and the current national average prices for fuel to the consumer.

I hope this information will be of use in your continuing consideration of the need for National Energy Conservation Construction Standards.

Yours very truly,

Joseph F. Kimpflen
Chairman, Technical Committee

cc: W.R. Werner
MIMA

JFK/sn
attachments/

ESTIMATED SAVINGS CALCULATIONS

ASSUMPTIONS

Size: 1500 sq. ft.
Wall area: 1280 sq.ft. (excluding windows and doors)
Oil: at $1/gal.
Gas: at $.39/therm*
Electric (Furnace) @ $.046/KWH

St. Louis - 4900 heating degree days

Δ Insulation	Savings/year	Oil	Gas*	Elec.
R-19 - R30 ceilings		$29	$16	$40
R-11 - R19 walls		$56	$30	$78
R-7 - R19 floors		$86	$47	$120
		$171	$93	$238

Additional material cost approximately $432

Pay back - 2.5 years/4.6 years/1.8 years

Air Conditioning - Assumptions

Light-colored roof
COP 1.7
St. Louis - 1140 cooling hours
.046¢/kwhr (Bureau of Labor statistics)

Δ Insulation (NAHB Manual Calculation) = $25/yr. savings

Minneapolis - 8250 heating degree days

Δ Insulation	Savings/year	Oil	Gas*	Elec.
R-19 - R38 Ceilings		$101	$49	$147
R-11 - R19 Walls		$ 95	$46	$137
R-11 - R19 Floors		$ 70	$34	$102
		$266	$129	#386

Additional material approximately $522
Pay back - 1.9 years/4.0 years/1.4 years

Dallas - 2320 heating degree days

Δ Insulation	Savings.year	Oil	Gas*	Elec.
R-11 - R22 Ceilings		$30	$13	$44
R-7 - R13 Walls		$24	$10	$35
R-0 - R13 Floors		$183	$78	$265
		$237	$101	$344

Additional material approximately $511
Payback - 2.2 years/5.0 years/1.5 years

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* Note: All gas numbers are based on current national average prices. Per DOE objectives & authorized deregulation this should accelerate rapidly.

Senator **Durkin**. Because I am concerned on what the difference in savings would be between the FmFA, BEPS, and the ASHRAE standards because it is significant.

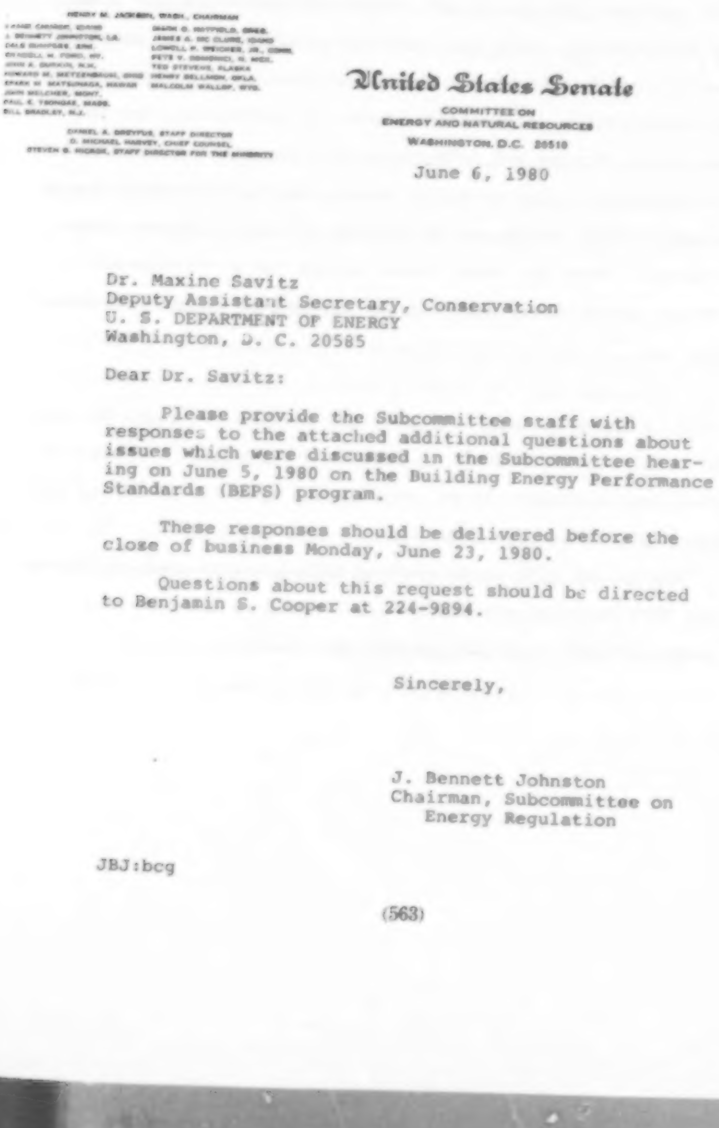
I don't have any further questions now, and would like to thank you all for the testimony. The hearing is concluded.

[Whereupon, at 1:05 p.m., the hearing was adjourned.]

APPENDIXES

APPENDIX I

Questions Answered for the Record by the Department of Energy



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United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, D.C. 20510

June 6, 1980

Dr. Maxine Savitz
Deputy Assistant Secretary, Conservation
U. S. DEPARTMENT OF ENERGY
Washington, D. C. 20585

Dear Dr. Savitz:

Please provide the Subcommittee staff with responses to the attached additional questions about issues which were discussed in the Subcommittee hearing on June 5, 1980 on the Building Energy Performance Standards (BEPS) program.

These responses should be delivered before the close of business Monday, June 23, 1980.

Questions about this request should be directed to Benjamin S. Cooper at 224-9894.

Sincerely,

J. Bennett Johnston
Chairman, Subcommittee on
Energy Regulation

JBJ:bcg

1. What energy savings are you estimating will result from implementation of BEPS? Why is this number so much less than was estimated for the program in 1976? (the 1976 estimate--which Senator Kennedy quoted in the Record only recently--was 12.5 million b/d)

2. Would you outline the calculation of the design energy budget for four specific examples, showing how DOE obtained the proposed BEPS standard? Outline calculations for homes heated with oil, with gas, and with electricity and provide, for the gas-heated home a second calculation assuming electric airconditioning is provided. Show, in particular, how the weighting factors and life-cycle cost estimates enter these calculations. Your examples should show how different design energy budget levels are arrived at for the different fuel sources. Show how these levels change for a "site-based" energy accounting methodology as opposed to a "resource based" one.

3. What is the statutory authority for the use of weight factors? Do these factors attempt to influence the use of one kind of fuel over another? If so, what is the specific authority upon which DOE relies for this?

   How do the life cycle costing methodologies used in developing BEPS discriminate among fuels? What is the specific authority upon which DOE relies for this?

4. What authorities does the Federal government have available to implement a BEPS standard without additional Congressional action? Be specific as to each authority describing the statute, implementing agency and the types of buildings covered.

5. What staffing and funding levels are necessary to arrive at a workable final rule under the schedule you announced at the June 5 hearing? Are the current budget requests of the President before Congress (FY 80 supplemental and FY 81) adequate?

6. Is legislation necessary to transfer the implementation responsibility from HUD to DOE? Isn't it possible to use generic reorganization authority to accomplish this transfer?

7. If your proposed rule is not promulgated before August 14, 1980 and existing law is not amended (as the Banking Committees propose) to change the statutory deadline, what happens? Is your authority to promulgate a final rule at a later date affected? If so, how?

8. How does the proposed BEPS standard distinguish between electric resistance heating and heat pumps powered by electricity?

9. Explain how the proposed BEPS standard treats solar energy in arriving at a design energy budget level.

10. Please supply the Subcommittee with alternative options for enforcement of the proposed BEPS standard including the establishment of a Federal warranty tied to the standard. Indicate for each option the existing statutory authority to be used and whether DOE would seek any additional authority.

11. Provide examples showing how with existing technology the proposed BEPS standard can be met for single-family detached houses in Baton Rouge, Louisiana.

12. How does the BEPS standard for commercial buildings change for different choices of weighting factors?

Q. What energy savings are you estimating will result from implementation of BEPS? Why is this number so much less than was estimated for the program in 1976? (The 1976 estimate--which Senator Kennedy quoted in the Record only recently--was 12.5 million b/d.)

A. The 1976 estimated was not made by DOE. After making several inquiries regarding the source of the estimate, it appears to be based upon a recent advertisement. The 12.5 million b/d was cited in a May 21, 1980, Washington Post advertisement paid for by the American Institute of Architects (AIA). The source for the estimate referred to in the advertisement is two 1977 AIA publications, Energy and the Built Environment and A Nation of Energy Efficient Buildings. The estimate of 12.5 million b/d includes both existing and new buildings. It should be noted that the total buildings sector current energy consumption is only 13.0 million b/d of oil equivalent. Necessarily, DOE's savings estimates for the BEPS program relate only to new construction.

The current DOE estimates are based upon very conservative assumptions. For example, DOE estimates that there will be a 40 percent penetration rate as a result of the HUD Minimum Property Standards. The effect is that projected energy savings increments above this base are not as large as in a pesimistic scenerio with lower penetration rates. Other examples of the conservative assumptions used by DOE include:

- No periodic update of the standards;
- slow penetration rate of heat pumps.

Also, the DOE analysis assumes that consumers respond to more energy efficient BEPS buildings by increasing their amenity level. This assumption reduces energy savings and enhances the standard of living.

In 1976, it was estimated 0.5 million b/d would be saved by BEPS in 1985. This was before the Energy Policy and Conservation Act (EPCA) State grant program passed which required States to implement five mandatory conservation measures. This program and other actions have resulted in 44 States now having some form of thermal efficiency standards for new buildings.

The BEPS program is expected to save approximately 27 million b/d equivalent in 1990; .36 million b/d in 1995; and .437 million b/d in 2000.

Cumulative savings between 1990 and 2020 are 4,988,000,000 barrels of oil equivalent.

Much larger savings would result if updated, more stringent standards, which include more building types, are assumed.

Q. Would you outline the calculation of the design energy budget for four specific examples, showing how DOE obtained the proposed BEPS standards? Outline calculations for homes heated with oil, with gas, and with electricity and provide, for the gas-heated home a second calculation assuming electric air conditioning is provided. Show, in particular, how the weighting factors and life-cycle cost estimates enter these calculations. Your examples should show how different design energy budget levels are arrived at for the different fuel sources. Show how these levels change for a "site-based" energy accounting methodology as opposed to a "resource based" one.

A. The following is the general description of how the Design Energy Budget is calculated. More detail can be found on pages 4-3 through 4-44 of the attached Economic Analysis Document (TSD 118). Complete detail sufficient to repeat the calculations for any of the 10 cities studied by DOE, as well as an explanation of how the calculations may be performed, is provided in the attachment entitled "Lawrence Berkeley Laboratory Residential Building Energy Performance Standards Series V Results," dated February 7, 1980. The following is a generalized procedure used to calculate design energy budgets for each fuel use assumption:

Step 1: Describe the prototype house (full information for DOE's prototype found in Appendix A of TSD 118).

Step 2: Use the public domain computer program DOE-2 to evaluate the heating and cooling loads of the house in the climate of interest; convert heating and cooling loads to heating and cooling energy. (Results shown in attachment)

Step 3: Calculate the annualized cost of energy conservation measures and the fuel savings in going from one conservation measure to the most cost effective measure. (Equations found on page 4-14 of TSD 118; assumptions found in TSD 118 and the attachment; results found in the attachment.)

Step 4: Set the unweighted budget equal to the set of conservation measures for which the marginal benefit is just greater than the marginal cost, i.e., for which benefit/cost ratio of the measure relative to the preceding measure is the smaller number greater than 1.0 in the results shown in the attachment.

Step 5: Correct the energy budget to express it in weighted terms, using the weighting factor for electricity from the Notice of Proposed Rulemaking.

The weighting factors affect the magnitude of the Design Energy Budget by multiplying electrical energy use at the site by the appropriate factor (2.79 for single family residential buildings).

LAWRENCE BERKELEY LABORATORY February 7, 1980

RESIDENTIAL BUILDING ENERGY PERFORMACE STANDARDS

SERIES V RESULTS

The LBL Series V results from the analysis of building energy performance standards are those that are used as input to DOE's Notice of Proposed Rulemaking. They result from the various refinements and calculations that have been performed on DOE-1 and DOE-2 at LBL since December, 1978. To our knowledge, the results are free of error and can be fully reproduced if the same assumptions are adopted in the DOE-2 modeling that we have performed.

The main purpose of this summary is to make available for use of others the results of the computer runs and the economic analysis that was performed on these runs. For this purpose, the computer outputs from the life cycle costing model (BEPSECON) which has used the outputs of DOE-2 are presented. We proceed to explain the output, discussing the numbers that are on a sample data page from a run for Chicago at a 3% discount rate. (This sample page is found at the end of this writing.)

First Series of Outputs

Line 1 presents the city and the type of house that is being analyzed. The ONE STORY HOUSE follows Hastings (BNSIR 77-1309, 1977) and contains 1176 square feet.* Line 2 notes that the runs presented for the base case series are based on NATIONAL PRICES.+ The next set of four lines describes the economic assumptions that have been made for analyzing base case results. The prices are reported in constant 1978 dollars for 1981, the first year in which BEPS goes into effect. Thus, the gas price in 1981 is \$0.34 per therm (10^5 Btu) and the escalation rate on gas prices is taken to be 2.8% per year (real, i.e., in constant dollars).

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*Other options which will be included in the full series are a two story house (1944 square feet), a townhouse (1315 square feet), and a split level house (1838 square feet)

+The other option that has been evaluated uses regional prices and regional price escalation factors from the EIA medium price forecasts.

Similarly, the 3% discount rate is a real discount rate and would correspond to 10% or 11% with inflation. (A second and third series of runs at a 5% and 10% discount rate respectively is also presented). Although oil prices and escalation rates are given, they are not used in any of the runs reported.

The next series of outputs summarizes the mose important information from the runs. These results are discussed column by column. "Option" contains the coding of the conservation measures for a given run. BC means base case and is taken to be current practice in the construction of new residences in each of the cities/regions considered, based on data from the American Institute of Architects/Research Corporation (1975). It is not now known if energy conservation in new houses has changed significantly since 1975. The designation O means a house with no insulation in its walls or roof and is always presented last. The letter after the space, in this case B, means a house with a full basement. (In other cities, houses with crawl space, denoted C, or slab on grade, designated S, are analyzed for the base case runs).

The first three columns under the heading "Option Description" are the R-values (in units of hrs. °F ft^2/Btu) for the ceiling, wall, and floor insulation, respectively. (The floor insulation is blank since with a full basement we have assumed, following ASHRAE and simple calculations we have made, that there is no or very little net heat exchange between the basement and the rest of the house (for an unconditioned basement which receives some heat from the furnace and ductwork). The next column describes the number of glazings on the windows of the house — 1, 2, or 3. The next column refers to infiltration rate: HI is taken to be 0.6 air changes per hour and LO is 0.3 air changes per hour.** The last column in this set is a remark: RE means that the option is repeated; OO means that it is out of

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**More precisely, for the LO case, the house is built tight enough that only 0.2 air changes per hour occur naturally under average temperature and weather conditions. An additional 0.4 air changes per hour of controlled air flow is vented through a heat recuperator of 75% efficiency. Thus, the house has a total of 0.6 air changes per hour and loses heat to the outside air as if it had an infiltration of 0.3 air changes per hour.

order (done for the house with no insulation so that be base case describing current practice can be used for purposes of comparison). Where there is such a designation, the entries under Benefit Cost Ratio may have limited meaning or will be out of sequence so that they will generally not be used directly.

The column headed "Option Cost" refers to the cost relative to the preceding option. Thus, for option D4, $222.83 is the cost in 1978 dollars in going from R-19 ceiling to R-38 ceiling insulation (no change in wall insulation or number of glazings). Similarly, $427.89 is the estimated cost in going from option E4 to option G4 (double to triple glazing) for the 1176 square foot Hastings house. (For houses of differing sizes and designs, different conservation costs need to be used. As a first approximation, one could scale the conservation costs by the area of the house). A negative cost, such as is entered in going from H4 to E4, means that the conservation level has been reduced in the latter option. This was done in this case (as a repeated entry) to provide a direct evaluation of the cost effectiveness of the first option in the low infiltration series (LO) that follow option E4.

The column headed "Annualized Cost" is the cost to pay back the increased mortgage plus interest payments on the increased investment is the conservation measure if equal payments are made each year. This annualized cost is obtained by multiplying the entry under "Option Cost" by the annuity factor appropriate for a particular discount rate. It is the annualized cost relative to the preceding option, following the same convention that was used for the preceding column. Thus, increasing ceiling insulation from R-30 to R-38 would have a total cost of $88.49 and would increase annual payments on a thirty year mortgage by $4.51 (in constant 1978 dollars).

The column headed "Heating Energy" is the gas heating requirements (i.e., heating load divided by 0.7 efficiency) of the single story house in thousand Btu's per square foot per year. The heating energy must be multiplied by the Resource Utilization Factor (RUF) to calculate units of primary energy required to meet the space heating of the house. The entry is obtained from the DOE-2 simulation of the Hastings house with the conservation measures specified.

The "Cooling Energy" entries are also derived from the DOE-2 computer simulations. The efficiency of cooling (coefficient of performance) can be calculated from the Energy Efficiency Ratio (EER, thousand Btu's heat removed per kilowatt hour expended) presented in the last column by dividing the EER by 3.413. We have incorporated an air conditioner model into the DOE-2 program and have taken a rate of EER of 8. The seasonal EER as calculated in the model from hourly weather data (including variations in EER with temperature, relative humitity, and capacity of utilization) for a 1.5 ton air conditioner is presented.

The entry under "Energy Budget" is the building boundary energy use in thousand Btu per square foot per year for the house with the specified conservation measures; it is not a difference from the preceding option. The energy budget is the sum of the heating and cooling energy for gas heating and electric air conditioning.

The "Annual Fuel Benefit" of a given option is the total reduction in fuel costs (expressed as an annualized present value in 1978 dollars) relative to the preceding option. As such, the benefits expressed in this column can be compared directly with the annualized cost of conservation (in the fourth column) and it is this ratio that determined the Benefit Cost Ratio of a given option compared with the preceding option for gas heating at the specified discount rate, gas costs (and electric costs for air conditioning) and escalation rates, and costs of energy conservation measures. Note that these are marginal benefit cost ratios in that they compare benefits and costs only in going from one option to the next tighter one. The overall benefit cost ratio for the entire package, compared to the base case, would be substantially greater than the marginal benefit cost ratio of the last conservation measure in the package. If the list is followed sequentially from top to bottom until a benefit cost ratio of just above unit is reached, then the "optimum" measure is found, so long as the list is in the proper order. (The "optimum" measure can also be found in the second series of outputs as the measure with the lowest life cycle cost.) Note that the option that is repeated (RE) has a benefit cost ratio of less than one, meaning that it is not economically desirable to go to that option from the preceding (tighter conservation) option. As noted previously, this repeated entry is used to initiate the low infiltration options, which make up a different series of life cycle cost curves.

Under "Electric Heating" the same three column appear as were included in the "Gas Heating" column. The "Energy Budget", expressed in thousand Btu's/sq. ft./yr. building boundary energy, is the sum of the heating load (gas heating energy x 0.7) and the cooling energy for an electrically heated house. If a heat pump is installed, then the energy budget is the sum of the heating load divided by the heat pump coefficient of performance and the cooling energy. Because electricity is more expensive than gas, the savings in fuel bills (reflected in the "Annual Fuel Benefit" entry) will be greater for electricity at a given conservation level. For this latter reason, the marginal benefit cost ratio for a given option will always be greater for electricity than for gas as one proceeds from a weaker to a tighter level of energy conservation.

The entry under "EER" has already been explained.

Second Series of Numerical Outputs (Totals Relative to the Base Case)

Entries under "Option" and "Option Description" are the same as above. The "Option Package Cost" entry is the cost of the energy conservation in 1978 dollars relative to the base case, which is arbitrarily assigned a net cost of zero for ease of calculation. The "Life Cycle Cost" entries are the sum of the investment in conservation plus the present value of all fuel costs. Thus, the life cycle cost of the base case house consists of the present value of all fuel costs over the thirty years of the house mortgage, since conservation costs are defined to be zero for this case. (The "0" case gets a "credit", since no insulation in the "0" house corresponds to a lower cost than that of the "base case" house.) The entries under "Life Cycle Cost" have two minima for purposes of our treatment: one for the high infiltration case and one for the low infiltration case. The minima correspond to the lowest marginal benefit cost ratios greater than one in the results presented above. "Annualized Life Cycle Costs" are the life cycle costs multiplied by the annuity factor; the difference between any two entries in this column are differences in annual real costs that a homeowner would experience for the different conservation options, under the economic assumptions used. The entry under "Present Value of Fuel Benefits" is, as for all other entries in this series, relative to the base case. Note that in comparing any option with another, the difference in life cycle costs will be equal to the difference in present value of fuel benefits minus the difference in the option package cost.

ONE STORY HOUSE
EXAMPLE SHEET CHICAGO

```
ATIONAL PHILIN

ISCOUNT RATE= .03   ANNUITY FACTOR= .051        MORTGAGE PERIOD = 30 YEARS
AS PRICE=.392 $ PER THERM WITH AN ESCALATION RATE OF .028 PER YEAR
IL PRICE=.467 $ PER THERM WITH AN ESCALATION RATE OF .033 PER YEAR
LEC PRICE=1.19 $ PER THERM WITH AN ESCALATION RATE OF .015 PER YEAR

                                                                             GAS HEATING                      ELECTRIC HEATING
PTION          OPTION          OPTION  ANNUALIZED HEATING COOLING   ENERGY   ANNUAL  BENEFIT   ENERGY   ANNUAL  BENEFIT LEN
             DESCRIPTION        COST      COST    ENERGY  ENERGY    BUDGET    FUEL    COST     BUDGET    FUEL    COST    AIR
                                                                            BENEFIT   RATIO             BENEFIT  RATIO   COND
BC A     19,11,   ,2,HI,BA,       0.        0.     49.45    2.15     51.01     0.      0.       36.35     0.      0.     7.12
34 B     38,11,   ,2,HI,  ,     221.43     11.32   43.14    2.05     45.19    36.2    3.19      32.25    76.4    6.79   7.08
36 B     30,19,   ,2,HI,  ,     160.00      8.14   39.08    2.05     41.53    21.9    2.69      29.69    49.0    5.46   7.06
E4 B     33,19,   ,2,HI,  ,      86.00      4.51   37.92    2.03     39.95     9.8    2.17      29.57    29.9    4.63   7.04
64 B     33,19,   ,3,HI,  ,     427.49     21.83   33.29    1.       35.04    32.7    1.50      25.06    69.7    3.01   7.00
45 B     38,27,   ,3,HI,  ,     295.77     15.09   31.05    1.75     32.55    13.2     .47      21.53    29.7    1.91   6.99
E4 A     38,19,   ,2,HI,RE,    -723.66    -36.92   37.92    2.03     39.95   -45.9     .61      29.57   -93.5     .34   7.04
81 B     38,19,   ,2,LO,  ,     809.61     25.48   26.18    2.01     26.15    82.9    3.25      14.91   181.0    7.10   6.
H1 B     38,19,   ,3,LO,  ,     427.49     21.83 / 19.46    1.75     21.43    31.5    1.44      15.52    63.4    2.40   6.7
I1 B     38,27,   ,3,LO,  ,     295.77     15.09   17.42    1.75     19.37    12.3     .82      14.09    25.4    1.79   6.75
0  A     0 ,0 ,   ,1,HI,30,   -2534.6    -129.3   125.2     3.09    129.25  -675.2     .19      91.40  -1448.     .09   7.46


TOTALS RELATIVE TO BASE CASE
                                                                  GAS HEATING                       ELECTRIC HEATING
                                 OPTION                  LIFE                   PV OF      LIFE                   PV OF
OPTION           OPTION          PACKAGE  ANNUALIZED     CYCLE   ANNUALIZED     FUEL       CYCLE   ANNUALIZED     FUEL
              DESCRIPTION         COST       COST        COST       LCC       BENEFITS     COST       LCC       BENEFITS
BC A     19,11,   ,2,HI,BA,        0.         0.        6526.5     333.0         0.       13105.1     680.9         0.
04 B     38,11,   ,2,HI,  ,      221.43      11.32      6039.6     308.1       708.7      12060.8     615.3      1506.2
36 B     30,19,   ,2,HI,  ,      341.43      19.68      5769.7     298.4      1139.6      11280.2     575.5      2445.7
E4 B     33,19,   ,2,HI,  ,      470.32      24.00      5646.1     289.1      1330.7      10959.1     559.1      2155.4
64 B     33,19,   ,3,HI,  ,      894.21      45.83      5453.1     279.2      1971.6      10098.2     515.2      4145.1
45 B     38,27,   ,3,HI,  ,     1193.49      60.92      5891.0     280.1      2229.4       9830.6     501.5      4708.6
E4 A     38,19,   ,2,HI,RE,      470.32      24.00      5646.1     289.1      1339.7      10959.1     559.1      2655.4
81 B     38,19,   ,2,LO,  ,      969.73      49.47      4541.2     231.7      2955.0       7911.1     403.6      6603.8
H1 B     38,19,   ,3,LO,  ,     1397.62      71.31      4350.9     222.0      3573.2       7097.1     362.1      7645.7
I1 B     38,27,   ,3,LO,  ,     1693.39      86.40      4404.9     224.7      3814.9       6864.8     350.2      8173.7
0  A     0 ,0 ,   ,1,HI,00,     -981.24     -82.92     15103.9     770.6     -9412.6      32713.4    1669.0    -20210.
```

Q. What is the statutory authority for the use of weight factors? Do these factors attempt to influence the use of one kind of fuel over another? If so, what is the specific authority upon which DOE relies for this? How do the life-cycle costing methodologies used in developing BEPS discriminate among fuels? What is the specific authority upon which DOE relies for this?

A. The statutory authority that authorizes DOE to provide for BEPS standards on an economically sound basis is contained in Title III, section 302 of the Energy Conservation and Production Act (Public Law 94-385). Weighting factors were based on the economic cost to the nation of various fuels, and thus the application of weighting factors is consistent with the statutory authority to achieve an economical standard.

However, the BEPS in the NOPR were set on both the economics of energy conservation of the individual and the nation. This was done by equating weighting factors to the cost of fuels and incorporating a premium for certain fuels, based on the Fuel Use Act. Thus, the weighting factors do have the effect of discouraging the use of certain fuels, consistent with the Fuel Use Act beyond what an individual's life-cycle cost analysis would direct. However, the use of weighting factors given in the NOPR would result in building energy consumption that is economical to the nation as a whole.

A life-cycle cost approach takes into account the cost of energy; thus life-cycle costing would discourage the use of the most expensive fuels. Basing the standards on life-cycle costs are clearly consistent with ECPA section 302's directive that the standard should be set to achieve "maximum practicable" conservation.

Q. What authorities does the Federal Government have available to implement the BEPS standard without additional Congressional action? Be specific as to each authority describing the statute, implementing agency and the types of buildings covered.

A. Section 252 of the National Energy Conservation Policy Act (NECPA) Public Law 95-619 requires revision of the HUD Minimum Property Standards and the standards of Farmer's Home Administration (FmHA) to meet the BEPS when they become effective. This means that all new construction subject to MPS (all subsidized and Federally insured housing programs) must comply. HUD and FmHA administer most of these housing programs. Their relative contribution to the national stock of housing construction is 15 percent.

Section 306 of the Energy Conservation and Production Act (ECPA), Public Law 95-385, requires the head of each Federal agency to adopt procedures necessary to assure that construction of Federal buildings will comply with the BEPS. Section 546 of NECPA further provides that energy performance targets are to be established by DOE for the construction of Federal buildings. DOE is the lead agency in the Federal Energy Management Program.

Section 305 of ECPA presently gives the Secretary of HUD the statutory authority to implement the BEPS through State and local Governments. Sections 307 and 308 give Secretary of HUD the authority to administer grant and technical assistance programs but to date no funds have been appropriated pursuant to these provisions. The Administration has requested transfer of implementation authority from HUD to DOE by both introducing legislation and the June 5th testimony to the Senate Subcommittee on Energy Regulation. The Senate supported this in the HUD FY 1981 Authorization Bill. The House FY 1981 Authorization does not contain a similar provision.

Section 381 et. seq. of the Energy Policy and Conservation Act (ECPA) Public Law 94-163, permits DOE to provide grants to States to adopt and implement energy conservation standards for new buildings. If the Energy Management Partnership Act is approved by Congress, DOE plans to broaden the coverage and increase the effectiveness of energy provisions in the State and local building codes.

Q. What staffing and funding levels are necessary to arrive at a workable final rule under the schedule you announced at the June 5th hearing? Are the current budget requests of the President before Congress (FY 80 supplemental and FY 81) adequate?

A. DOE currently has 10 authorized positions for the BEPS program. Only seven of those positions had been filled prior to the current personnel freeze. Since then, four of the seven have resigned leaving a current BEPS staff of only three. DOE had determined that the seven existing vacancies can be filled immediately under the ground rules of the hiring freeze. When the currently authorized positions are filled DOE will hire an additional 13, all of whom are necessary to undertake the reproposal. All available DOE laboratory resources including Lawrence Berkeley, Battelle Northwest, Oak Ridge and Brookhaven National Laboratories have been brought to bear on the program since the middle of last year. Once a method for implementation is determined, an assessment will be made of the staff necessary to carry out that aspect of the program.

The President's budget is adequate to carry out this program.

Q. Is legislation necessary to transfer the implementation responsibility from HUD to DOE? Is it possible to use a generic reorganization authority to accomplish the transfer?

A. As stated in the answer to Question 4, the Administration introduced legislation to transfer the BEPS implementation responsibility from HUD to DOE.

In the attached letter from Acting Secretary of HUD, Mr. Jay Jones, to Senator Charles Percy, the HUD position is clearly stated; that one Department should exercise total responsibility for standards development and implementation and that Department should be DOE. However, a legislative change is not the only way to transfer implementation authorities. 5 U.S.C. 901, et. seq. gives the President the authority to examine the organization of all agencies to determine what changes may be necessary to promote the better execution of the laws, the more efficient management of the executive branch, its agencies and functions. Thus, the President may transfer in whole or in part an agency or a function to the jurisdiction and control of another agency unless either House passed a resolution stating in substance that that House does not favor the reorganization plan.

AUG 14 1979

Honorable Charles H. Percy.
United States Senate
Washington, D.C. 20510

Dear Senator Percy:

You have indicated in your letter to me of July 16, 1979, that the position of this Department appears to now be inconsistent with that which was taken in 1977 in terms of where responsibility for Title III of the Energy Conservation and Production Act should be lodged. During the Congress' deliberations over the House and Senate bills proposing the organization and structure of the Department of Energy (DOE), this Department petitioned the Congress to retain full responsibility for the development, promulgation and implementation of the building energy performance standards with the Department of Housing and Urban Development (HUD). In Secretary Harris' letter to Senator Ribicoff, she stated more fully that:

> "The President's position is clear: The Department of Energy is to have overall authority for the building energy standards program, but authority for development, promulgation and implementation of the standards is to be delegated to HUD. Any other arrangement is inadequate and does not reflect the understanding reached between myself and Dr. Schlesinger on this point."

This Department's position has not changed in that we believed then--as we do now--that one Department should exercise total responsibility for standards development and implementation. The Congress, by its action, divided responsibility between the two departments, giving DOE responsibility for standards development and HUD maintaining responsibility for implementation. Additionally, DOE has undertaken a number of programs complimentary to Title III, such as the State Energy Conservation Program and the energy science research conducted by the Building Community Systems Office of DOE. Our experience since that time has convinced us that our original position supporting a full integration of standards development and implementation in a single Department is most practical. Therefore, we have supported legislation transferring the implementation responsibility to DOE, which would place the total responsibility within that Department. The overall principle in Secretary Harris' letter to Senator Ribicoff is the same except we now have experience to support the proposition that it is more expedient in terms of existing staff and financial resources to transfer the function to DOE.

In the Fourth Semiannual Report on Energy Conservation Standards dated March 2, 1979, the Department informed the Congress that it intended to transfer our Title III responsibility to DOE. Nonetheless, I regret that the Government Affairs Committee of the Senate was not specifically consulted about our intentions and will do everything in my power to correct this kind of oversight in the future. We will certainly welcome an opportunity to present our views at your convenience.

Sincerely yours,

/s/ Jay Janis

Jay Janis
Acting Secretary

cc:		
	Secretary	10000
	U/S	10000
	Mandel	10139
	Exec.Sec.	10132
	Crawford	10226
	Copeland	10222
	OGC	10214
	Admin.	10110
	IG	8256
	LIR	10120
	Murrell	4106
	Baroni	4100
	Worthy	4204
	Edwards ✓	4204
	Twitchell ✓	

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Retyped:abs 8/3/79

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Name		✓ 7/30/79				
Date	[illegible]					

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U.S. GOVERNMENT PRINTING OFFICE:

Q. If your proposed rule is not promulgated before August 14, 1980, and existing law is not amended (as the Banking Committees propose) to change the statutory deadline, what happens? Is your authority to promulgate a final rule at a later date affected? If so, how?

A. Essentially nothing happens. The authority to promulgate a final rule at any other later point in time is not affected.

Q. How does the proposed BEPS standards distinguish between electric resistance heating and heat pumps powered by electricity?

A. The residential design energy budgets do not distinquish between system options such as electric resistance and heat pumps. The residential design energy budgets were set with the assumption that houses heated with electricity will use a heat pump where the heat pump is cost effective when compared with alternative electric heating systems. As a result, the residential standard can be met in most instances with an electric heat pump. The economic analysis performed on heat pumps and competing electric heating systems revealed that heat pumps are cost effective in all but the warmest regions of the nation. For a discussion of the research results on the cost effectiveness of heat pumps, see Appendix A of the Technical Support Document #8, Economic Analysis). As a result, the residential standard can be met with a heat pump in almost all regions of the nation. The failure to use a heat pump in place of alternative electric heating systems will make it more difficult to meet the standard because of the higher efficiency of the heat pump. Even in the warmest regions, where the low heating requirement of the house cause the heat pump to be less cost effective than electric resistance heating, for example, the use of a heat pump with appropriate envelope energy conservation measures will meet the BEPS design energy budgets.

In short, BEPS tends to encourage the use of the heat pump over less energy efficient electric heating systems because it is both cost effective and an effective energy conservation measure in most regions of the United States.

Q. Explain how the proposed BEPS standard treats solar energy in arriving at a design energy budget level.

A. That part of a building's design energy consumption supplied by solar energy, i.e., solar heating, cooling, electricity or hot water is considered as a credit in the calculation of the building's design energy consumption. That is, it is not counted into the btu/square foot/year calculation. Thus, this energy is available to reduce the requirments for nonrenewable fuels making it easier for the designer to achieve his design energy budget. As an example, Table 3-1 from the Notice of Proposed Rulemaking, (a copy of which is attached), illustrates sets of options for meeting the proposed budgets in three locations. Renewable resources are among the options in each of the cities.

Table 3-1 illustrates several sets of options for meeting the proposed single-family residential Energy Budget Levels for three locations. These are some of the ways the Energy Budget Levels reported in Appendix I to the proposed rule can be achieved.

Table 3-1.—Illustrative Ways of Meeting the Proposed Energy Budget Levels for Single-Family Residences in Three Locations

Gas heated homes.	
Location	Sets of options
Chicago, IL	1. Average window area and distribution [1]; triple glazing [2]; R-38 ceiling and R-19 wall insulation. 2. Windows redistributed so that south facing window area increased by 75%, and east, west, and north facing window area decreased by 25%; double glazing; R-38 ceiling and R-19 wall insulation. 3. Active solar domestic water heating system [4]; double glazing; R-38 ceiling and R-11 wall insulation.
Atlanta, GA	1. Average window area and distribution [1]; double glazing; R-38 ceiling, R-19 wall, and R-11 floor [3] insulation. 2. Windows redistributed so that south facing window are increased by 75%, and east, west, and north facing window area decreased by 26%; double glazing; R-30 ceiling and R-11 wall and R-11 floor insulation. 3. Active solar domestic water heating system [4]; double glazing; R-19 ceiling, R-11 wall and R-7 floor insulation.
Houston, TX	1. Average window area and distribution [1]; double glazing; R-30 ceiling and R-11 wall insulation. 2. Active solar domestic water heating [4]; R-19 ceiling and R-11 wall insulation. 3. Other alternatives, such as passive solar design and redistribution of windows, not evaluated for Houston.
Chicago, IL	1. Average window area and distribution [1]; triple glazing [2]; R-38 ceiling and R-30 wall insulation; heating supplied by a heat pump. 2. Windows redistributed so that south facing window area increased by 30%, and east, west, and north facing window area decreased by 10%; triple glazing; R-38 ceiling and R-19 wall insulation; heating supplied by heat pump. 3. Active solar domestic water heating system [4]; double glazing; R-38 ceiling and R-25 wall insulation; heating supplied by electric resistance.
Atlanta, GA	1. Average window area and distribution [1]; triple glazing [2]; R-38 ceiling, R-19 wall, and R-11 floor [3] insulation; heating supplied by heat pump. 2. Windows redistributed so that south facing window area increased by 40%, and east, west, and north facing window area decreased by 27%; double glazing; R-38 ceiling, R-19 wall and R-11 floor [3] insulation; heating supplied by heat pump. 3. Active solar domestic water heating system [4]; double glazing; R-38 ceiling, R-19 wall, and R-11 floor [3] insulation; heating supplied by electric resistance.
Houston, TX	1. Average window area and distribution [1]; triple glazing [2]; R-38 ceiling and R-19 wall insulation; heating supplied by heat pump. 2. Active solar domestic water heating [4]; R-19 ceiling and R-11 wall insulation. 3. Other alternatives, such as passive solar design and redistribution of windows, not evaluated for Houston.

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[1] The average window area is 15% of total floor area. The windows are distributed equally among the exterior walls.

[2] Double glazing plus storm windows can substitute for triple glazing with little change in the Design Energy Consumption of the house.

[3] Floor insulation is noted in Atlanta, Georgia and all other areas where crawl space basements are used.

[4] The active solar domestic water system is assumed to supply 60% of the domestic hot water in a 1500 square foot house for the purpose of this illustration.

Q. Please supply the Subcommittee with alternative options for enforcement of the proposed BEPS standard including the establishment of a Federal warranty tied to the standard. Indicate for each option the existing statutory authority to be used and whether DOE would seek any additional authority.

A. Currently Public Law 94-385 describes how the standards should be implemented. Briefly, States will be involved in a certification program where they certify that their energy codes and the codes of the units of general purpose local governments meet or exceed the energy requirements of the standards. For areas where certified codes do not exist an alternate approval process will be available; and for areas with very low levels of construction an exemption may be obtained.

Section 305(c) of the Act requires the President on the date of promulgation to transmit DOE's final standards to both houses of Congress for a review by Congress which will ascertain whether to impose a sanction that "no Federal financial assistance shall be made available for any new commercial or residential building in any area of any state" unless certain actions are taken by State and local Governments to apply the standards.

If Congress does not approve the use of the sanction, there is still authority under EPCA (Public Law 94-163) to encourage States to adopt BEPS and ASHRAE type equivalent codes as a requirement for the receipt of State Energy Conservation Program or Energy Management Partnership Act funds.

Under section 252 of NECPA, Public Law 95-619, the Minimum Property Standards of the FHA and FmHA will be revised to meet the BEPS and section 546 of NEPCA requires that DOE publish energy performance targets compatible with the BEPS. Section 381 of Public Law 94-163 requires the President to set mandatory thermal efficiency and insulation requirements as part of the 10-year conservation plan for Federal buildings.

Additionally, DOE intends to increase the understanding and support for BEPS by having pilot programs and demonstrations of buildings in compliance with BEPS in a few of the leading States using different implementation mechanisms.

There is presently no statutory authority for Federal warranty, building labeling, or tax credit type programs. If Congress decides not to invoke the sanction specified in section 305, a voluntary program where States and local Governments are encouraged to adopt and revise their codes will result. Sections 307 and 308 of the ECPA permit the agency implementing BEPS to provide grants and technical assistance to code enforcement agencies to assist them in meeting the BEPS requirements. To date, however, no funds have been requested as appropriated pursuant to these provisions.

Q. Provide examples showing how with existing technology the proposed BEPS standards can be met for single family detached houses in Baton Rouge, Louisiana.

A. Recent work by DOE has identified a problem with the residential energy budgets in cities with warmer climates. The problem occurs when a regression analysis expands detailed life-cycle cost work in 10 U.S. cities to the 78 cities in the NOPR. Baton Rouge is one of those cites.

This problem will be solved in standards to be reproposed in the spring by basing them on a 33 city analysis.

DOE expects that BEPS standards may be met in a Baton Rouge single family detached house using existing technology and no change in construction practice by the following:

> Gas-heated or electric heat pumps and electrically air-conditioned--R-30 (10-inches fiber glass) ceiling insulation, R-11 (4-inches fiber glass) wall insulation, and double glazing.

This is based on a complete evaluation of New Orleans which has a very similar climate to that of Baton Rouge. Also under development is a Manual of Recommended Practice to translate BEPS performance measures into prescriptive alternatives such as those given here.

Q. How does the BEPS standard for commerical buildings change for different choices of weighting factors?

A. Under the present BEPS Notice of Proposed Rulemaking, DOE has proposed only one budget for commercial buildings, regardless of the fuel mix of the buildings. The effect of this proposal would likely reduce electric resistance heating for new commercial buildings (with a weighting factor of 3.08 for electric buildings using electricity in commercial applications) in most areas of the country in favor of new commerical buildings using electric heat pumps or other fuels. If the one budget approach were employed with a weighting factor of 1.0, the use of gas for space heating would probably be curtailed.

DOE recognizes the admittedly severe problems with a uniform fuel budget in the commercial building sector. This issue is now under consideration and subject of further study.

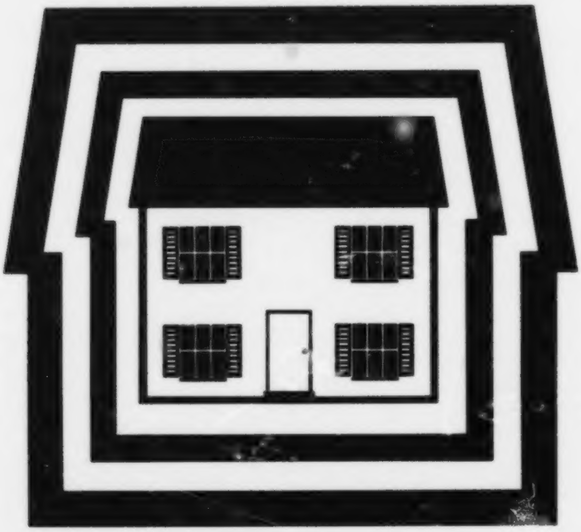
APPENDIX II

National Association of Home Builders Thermal Performance Guidelines for "One and Two Family Dwellings" and "Apartments and Condominiums"

NAHB
Thermal Performance
Guidelines

One and Two
Family Dwellings

The National Association of Home Builders
15th and M Streets, N.W.
Washington, D.C. 20005



Foreword

The thermal performance guidelines presented in this manual are practical, comprehensive and flexible. Based on sound engineering and economic practice, they permit a builder to select a balanced and cost-effective energy conserving package that will assure the home buyer economic benefits and living comfort while reducing the consumption of valuable energy resources. They must be considered a most important contribution to the homebuilding industry and to the people of the United States.

The guidelines in this manual were developed for NAHB by its wholly owned subsidiary, the NAHB Research Foundation, working with the association's technical staff—under the guidance of the NAHB Special Committee on Energy headed by Co-Chairmen Ivan Wohlworth of Hicksville, New York, and Jack Demetree of Jacksonville, Florida.

Special thanks go to these two gentlemen and all staff for their outstanding efforts in producing these guidelines.

Introduction

The ability to utilize techniques contained in this manual is important. With the many and varied recommendations on how much energy to save, and how much insulation to specify, or which energy conserving techniques to utilize, a clear, concise, and unbiased method of making cost-effective decisions is needed. Groups, on one extreme, are pressing for saving the maximum amount of energy. Other groups are interested in causing the least disruption to "business as usual." The techniques in this manual provide a proper and necessary balance in our Nation between saving energy and economic benefit. NAHB recommends that all persons keep clearly in mind that benefits must relate to costs in a reasonable way. While energy saving is vitally important to our Nation's future, the price that we pay to save energy cannot be ignored.

The members of NAHB, recognizing the importance of energy conservation in buildings, have in the past years developed and applied construction practices and utilized materials that have contributed greatly to increased energy efficiency in the homes, apartments, and other structures they have built. NAHB has pledged to continue to incorporate into all newly constructed homes, apartments, and commercial buildings the energy efficient techniques necessary to alleviate rapidly increasing heating and cooling costs.

As part of the Association's ongoing service to members and as part of its share in helping reduce energy consumption in this country, these NAHB Thermal Performance Guidelines for One and Two Family Dwellings have been developed.

The procedures described in this manual have a simple purpose—to help the builder conserve energy in a cost-effective manner. By taking the time to understand the steps outlined in this manual, the builder can take advantage of the best engineering and economic judgments of the NAHB Research Foundation, NAHB's technical staff, and the Special Committee on Energy.

Basic assumptions used in developing these guidelines were:

- Guidelines should be based on performance, NAHB's historic approach; not specification standards.
- Freedom of choice in design should be maintained.
- A procedure that develops a balanced package of energy saving features is necessary.
- The selection of each individual item must be cost-effective.

The guidelines in this manual are intended for one and two family dwellings. While the illustrations are based on a 7-year maximum time-to-recoup investment, the methods of modifying the procedure for other economic assumptions are also included.

Additional marketable features realized by following these guidelines include a more comfortable living unit due to reduced drafts and increased inside temperature of exterior walls; better protection from outside noise due to tighter fitting doors and windows, double glazing and insulation; and cleaner homes due to less air-infiltration.

Resale value of a home will be enhanced as a result of increased thermal performance because the home's competitive position will improve over time as energy prices rise.

Finally, the builder helps conserve the nation's energy supply, which in turn helps reduce our balance of payments deficit and improves the value of the dollar in foreign markets. This tends to improve the general economic climate.

Procedure

How To Use the Bar Charts

The bar charts contained in this manual have been developed using average national costs for each energy conserving technique shown. Specific economic assumptions used in these bar charts are:

- Time-to-recoup investment of 7 years
- An annual increase in energy cost of 10 percent in current dollars.
- An alternative investment interest rate of 9 percent.

The assumptions result in a Present Worth Factor (PWF) of 7.26. For example, any proposed thermal improvement expected to save $50 per year in energy costs means a maximum of 7.26 times $50 can be spent for the improvement if the decision is to be made on a cost-effective basis.

This manual uses an Energy Index (EI) concept that enables builders to calculate answers on a local basis using their own specific information. Any combination of energy cost increase, interest rate, time-to-recoup investment, or owner cost may be used to calculate a builder's indices. Procedures for this calculation are found on page 27.[1] A number of important techniques that do not lend themselves to the index concept are discussed in a separate section.

The user of this procedure is strongly encouraged to calculate breakpoints on a local basis, using local owner cost and energy cost information. Examples of local breakpoint calculations are shown in the Appendix.

Several examples of how these guidelines can be utilized in the selection of appropriate levels of cost-effective thermal protection are presented on the following pages. Working through these problems will develop the familiarity needed to calculate an EI quickly and easily so that anyone may apply it to a specific construction technique.

Definitions

Heating Index (HI): A measure of the heating cost for a given geographic location.

Cooling Index (CI): A measure of the cooling cost for a given geographic location.

Adjustment Factor (r): A varying number that modifies the cooling index to account for the effects of the sun on different elements of the building.

Energy Index (EI):[2] The sum of the HI and the product of the adjustment factor and the CI, or EI = HI + (r)CI.

Energy Conserving Technique (ECT): Any construction technique that serves to conserve energy.

Energy Index Breakpoints (EIB): The energy index number in the bar chart that provides exactly a 7-year payback in energy savings for the additional expenditure for the thermal improvement immediately to the right of the breakpoint.

Present Worth Factor (PWF):[3] The number that equals the dollars that can be spent now to save $1 on energy bills during the first year.

Seasonal Heating Efficiency: The seasonal efficiency of a particular type of heating system when it is installed properly and operating under actual conditions.

Energy Efficiency Ratio (EER): The rating of an air-conditioning unit that indicates how efficiently electricity is converted into cooling energy.

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[1] The lowest level of thermal performance for each ECT is that level required by the HUD Minimum Property Standards, including all revisions prior to October, 1977.

[2] The EI quantifies the effect on annual energy use produced by an Energy Conserving Technique (ECT). For an assigned time-to-recoup investment, the EI equates the aggregate savings (for both heating and cooling seasons) to the initial owner cost for a particular ECT.

[3] A table of PWFs for other economic assumptions is included in the Appendix, along with the necessary procedure to calculate Energy Index Breakpoints (EIBs) for any combination of energy cost increase, alternate investment rate, time-to-recoup investment, or owner cost of improvement.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days .... = 8250

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 26.) .... = $ 2.09

Line 3. Multiply Line 1 × Line 2 .... = 1724

Line 4. Estimate seasonal heating efficiency (see discussion, page 26.) .... = 0.60

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ = 2874

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours .... = ________

Line 6. Enter dollar cost per Kwh for air-conditioning .... = $ ________

Line 7. Multiply, Line 5 × Line 6 × 100 .... = ________

Line 8. Estimate seasonal EER of equipment .... = ________

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = ________

Adjustment Factor (r):

Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the "Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)" page 31.

Local Energy Indices (EIs):

		HI	+	(r)	CI	=	EI
Ceilings	=	2874	+	(1.0)	________	=	2874
Frame Walls Floors Over Open Spaces	=	________	+	(1.0)	________	=	________
Masonry Walls Rigid Roof Decks	=	________	+	(0.7)	________	=	________
Windows and Patio Doors	=	________	+	(0.6)	________	=	________
Ducts In (Note: r varies, see appropriate bar graph)	=	________	+	(___)	________	=	________
Perimeter Slab Edges Floors Over Crawl Spaces Basement or Crawl Walls	=	HI ONLY				=	________
Other (describe) ________	=	________	+	(___)	________	=	________

____

(Date) ________________

Sample Problem One

The Problem: How much blanket ceiling insulation should be used in a home in Minneapolis that is heated by a system fueled with natural gas?

The Solution: Make a copy of the "Local EIs" worksheet found on page 12. You will need a calculator, pad, ruler, telephone, and a couple of sharp pencils.

1 Turn to the Degree Days and Cooling Hours list beginning on page 20. The reference for Minneapolis is 8,250. Write that figure here.

2 Call your local natural gas supplier and find out the price of energy for space heating in units of $/100,000 Btu. The supplier will tell that the cost for natural gas at the appropriate step, including various service charges, fuel cost adjustments, surcharges, and taxes, is $0.209/100,000 Btu. Write that figure here.

3 Multiply line 1 by line 2 and enter the answer here.

4 Call your local mechanical engineer or heating contractor to find the seasonal efficiency of your specific heating equipment. If the contractor doesn't answer, you can use the generalized information found on page 26. In this case, the contractor does answer. The seasonal efficiency for gas is 0.60. Write that figure here.

5 Divide line 3 by line 4. In this case, the answer is 2,874. Write that figure here.

Since this problem involved only heating, your local Heating Index (HI) is the only Energy Index (EI) you are concerned with at the moment. Turn to page 13 and find the bar for ceiling insulation. Take your ruler and move along the top of the chart to your HI, 2,874. Make a mark with your pencil and follow the ruler down the page to the ceiling insulation bar. Read your value. In this case it is R-19.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days . . . . = ________
Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 26.) . . . . = $ ________
Line 3. Multiply Line 1 × Line 2 . . . . = ________
Line 4. Estimate seasonal heating efficiency (see discussion, page 26.) . . . . = ________

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ = $\boxed{}$

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours . . . . = 3250
Line 6. Enter dollar cost per Kwh for air-conditioning . . . . = $ .0484
Line 7. Multiply, Line 5 × Line 6 × 100 . . . . = 15730
Line 8. Estimate seasonal EER of equipment . . . . = 7.0

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = $\boxed{2247}$

Adjustment Factor (r):

Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the "Worksheet to Determine a Local Energy Index [illegible] (EIB) for an Energy Conserving Technique (ECT)" page 31

Local Energy Indices (EIs):

		HI	+	(r)	CI	=	EI
Ceilings	=	________	+	(1.2)	2247	=	2696
Frame Walls . . . . Floors Over Open Spaces	=	________	+	(1.0)	________	=	________
Masonry Walls . . . . Rigid Roof Decks	=	________	+	(0.7)	________	=	________
Windows and Patio Doors	=	________	+	(0.6)	________	=	________
Ducts in . . . . (Note: r varies, see appropriate bar graph)	=	________	+	(___)	________	=	________
Perimeter Slab Edges . . . . Floors Over Crawl Spaces . . . . Basement or Crawl Walls	=	HI ONLY				=	________
Other (describe) ________ ________	=	________	+	(___)	________	=	________

(Date) ________

Sample Problem Two

The Problem: How much blanket ceiling insulation is justified for only cooling a house in Coral Gables. Florida, when the home is utilizing electric, central air-conditioning.

The Solution: As in problem one, you will need your telephone, a copy of the "Local Els" worksheet, a calculator, a ruler, and pencils.

1 Turn to the Degree Days and Cooling Hours list beginning on page 20. Immediately you will find a new problem. Coral Gables has no entry. If your city is not listed in the tables, you may use the data for the nearest city listed and arrive at a fairly accurate answer. However, for the most accurate results, you are strongly urged to call your local weather service. In this case the weather data of the nearest listed city (Miami) is used. The figure is 3,250. Write the figure here.

2 Call your local electric company and get the price of energy for space cooling in units of $/Kwh. Make sure it includes the various fuel cost adjustments, surcharges, and taxes. In this case, the price is $.0484.

3 Multiply line 5 by line 6 and that answer by 100. Write that figure here.

4 Call your local mechanical engineer or HVAC contractor. Find out the Energy Efficiency Ratio (EER) for your specific equipment. In this case it is 7.0. Write that figure here.

5 Divide line 7 by 8. Write that figure here. This figure is your local Cooling Index (CI).

The CI must be adjusted when determining the EI. The worksheet gives you the proper correction factor. In the case of ceiling insulation, it is listed as (r) = 1.2. The result of multiplying 1.2 by 2,247 is your EI.

Turn to the Energy Index on page 13. Use your ruler and mark off the answer, 2,696. Drop vertically to the bar. The value is R-19.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days . . . . = 5550

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 26.) . . . . . . = $ 0.244

Line 3. Multiply Line 1 × Line 2 . . . . = 1354

Line 4. Estimate seasonal heating efficiency (see discussion, page 26.) . . . . . . = 0.60

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ = 2257

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours . . . . = 770

Line 6. Enter dollar cost per Kwh for air-conditioning . . . . = $ 0.0985

Line 7. Multiply, Line 5 × Line 6 × 100 . . . . = 7585

Line 8. Estimate seasonal EER of equipment . . . . = 8.0

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = 948

Adjustment Factor (r):

Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the **"Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)"** page 31.

Local Energy Indices (EIs):

		HI	+	(r)	CI	=	EI
Ceilings	=	2257	+	(1.2)	948	=	3395
Frame Walls Floors Over Open Spaces	=	____	+	(1.0)	____	=	____
Masonry Walls Rigid Roof Decks	=	____	+	(0.7)	____	=	____
Windows and Patio Doors	=	____	+	(0.6)	____	=	____
Ducts In . . . . (Note: r varies, see appropriate bar graph)	=	____	+	(__)	____	=	____
Perimeter Slab Edges Floors Over Crawl Spaces Basement or Crawl Walls	=	HI ONLY				=	____
Other (describe)____________ ____________	=	____	+	(__)	____	=	____

(Date) ______________

Sample Problem Three

The Problem: How much blanket ceiling insulation is justified in Hicksville, N.Y., for both heating and cooling? Natural gas is the heat energy source. Electricity is the cooling energy source.

The Solution:

Although this problem is more complex, the initial steps are identical. The same tools are needed. The heating problem will be solved first.

1 Turn to the Degree Days and Cooling Hours list beginning on page 20. The proper number of degree days is 5,550. Write that figure here.

2 Call the natural gas company and find out the price of energy for space heating in units of $/100,000 Btu. Make sure the unit price used includes the various fuel adjustments, surcharges, and taxes. In New York the price is $0.244/100,000 Btu. Write that figure here.

3 Multiply line 1 by line 2. Write that figure here.

4 Call your local mechanical engineer or heating contractor to find out the seasonal efficiency of your specific heating equipment. If you have to, you may use the seasonal efficiencies found on page 25. For gas, it is 0.60. Write that figure here.

5 Calculate your local HI by dividing line 3 by line 4. The answer is 2,257. Write that figure here.
Now, solve the cooling problem.

6 Turn back to the reference table on page 20. The cooling hours for Hicksville are 770. Write that figure here.

7 Call your electric company and find out the price of energy for space cooling in units of $/Kwh. Make sure the unit price includes the various fuel adjustments, surcharges, and taxes. For Hicksville, it is $0.0985/Kwh. Write that figure here.

8 Multiply line 5 by line 6 and that answer by 100. Write that figure here.

9 Call your local mechanical engineer or electrical contractor to find out the EER for your specific equipment. In this case it is 8.0. Write that figure here.

10 Calculate your local CI by dividing line 7 by line 8. The answer is 948. Write that figure here.

11 Now you are ready for the new part — reconciling the HI and CI. The worksheet gives you the proper correction factor. In the case of ceiling, it is listed as (r) = 1.2. Write the HI from line 5 here. Multiply the CI by 1.2 and add the HI. The result is your EI, 3,395. Write that figure here.

12 Just as before, find 3,395 on the table on page 13. Drop vertically to the ceiling bar. The answer is R-30.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days . . . . = ______

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 26.) . . . . = $ ______

Line 3. Multiply Line 1 × Line 2 . . . . = ______

Line 4. Estimate seasonal heating efficiency (see discussion, page 26.) . . . . = ______

Local Heating Index (HI) $= \frac{\text{Line 3}}{\text{Line 4}} =$ ______ = ☐

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours . . . . = ______

Line 6. Enter dollar cost per Kwh for air-conditioning. . . . . = $ ______

Line 7. Multiply, Line 5 × Line 6 × 100 . . . . = ______

Line 8. Estimate seasonal EER of equipment . . . . = ______

Local Cooling Index (CI) $= \frac{\text{Line 7}}{\text{Line 8}} =$ ______ = ☐

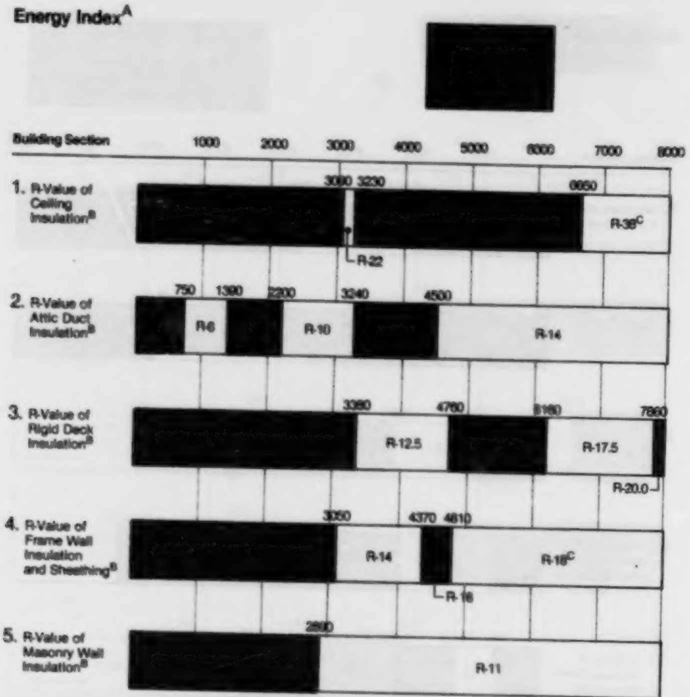
Adjustment Factor (r):

Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the **"Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)"** page 31.

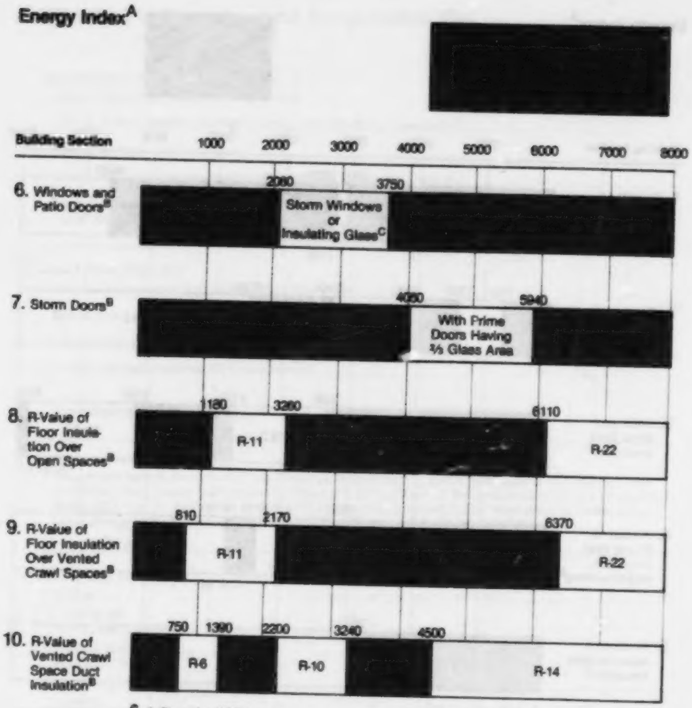
Local Energy Indices (EIs):		**HI**	+	**(r)**	**CI**	=	**EI**
Ceilings	=	______	+	(1.2)	______	=	______
Frame Walls Floors Over Open Spaces	=	______	+	(1.0)	______	=	______
Masonry Walls Rigid Roof Decks	=	______	+	(0.7)	______	=	______
Windows and Patio Doors	=	______	+	(0.6)	______	=	______
Ducts In (Note: r varies, see appropriate bar graph)	=	______	+	(___)	______	=	______
Perimeter Slab Edges Floors Over Crawl Spaces Basement or Crawl Walls	=	HI ONLY				=	______
Other (describe) ______	=	______	+	(___)	______	=	______

(Date) ______________

Energy Index[A]



1. A. EI = HI + 1.2 CI
   B. Based on installation of blanket insulation. Because loose fill insulation performance and installed costs vary widely, apply local information to the procedure shown in the Appendix to determine local guidelines.
   C. Calculated on the basis of conventional trusses, 24" O.C., with compression of the insulation at and near the eaves.
2. A. EI = HI + 2.0 CI
   B. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table E on page 17.
3. A. EI = HI + 0.7 CI
   B. Applies to open beam construction. For flat or sloped ceilings with gypsum board interior finish, use the ceiling insulation bar graph above. Approximate deck insulation thicknesses are shown in Table B on page 17.
4. A. EI = HI + CI
   B. R-values shown are the sum of the thermal resistances of insulation and sheathing. Approximate sheathing R-values are shown in Table C on page 17.
   C. Index shown is the average of three construction techniques (R-13 + 1" extruded polystyrene, R-11 + 1" isocyanurate or polyurethane, compressed R-19 between 2" × 6" framing member + conventional sheathing).
5. A. EI = HI + 0.7 CI
   B. R-3 based on aluminum foil backed gypsum board on 1" furring. R-11 based on blanket insulation between 2" × 3" framing members set out 1" clear of masonry. For brick veneer walls, use guidelines shown above for frame walls.



6. A. EI = HI + 0.6 CI
   B. Applies to all sash materials and glazing systems. Assumes thermal break in sash with multiple glazing.
   C. Basement windows require an index of at least 4780 to justify storm panels.
   D. Triple glazed patio doors generally not available.

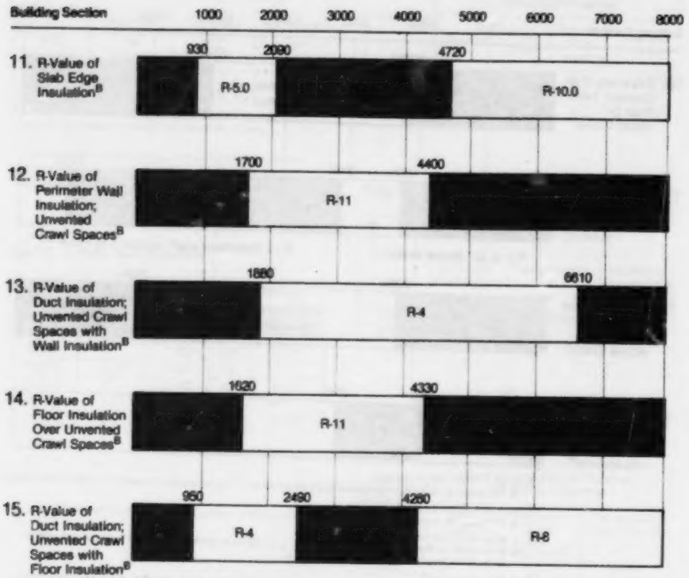
7. A. CI = HI (CI not considered)
   B. Addition of storm doors to solid doors and insulated doors requires indices of at least 9600 and 21390 respectively.

8. A. EI = HI + CI
   B. Applies to cantilevered floors and floors of living areas over garages and carports.

9. A. EI = HI (CI not considered)
   B. Applies to floors over vented crawl spaces with fixed permanently open wall louvers.

10. A. EI = HI + CI
    B. Applies to vented crawl spaces with floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table E on page 17.

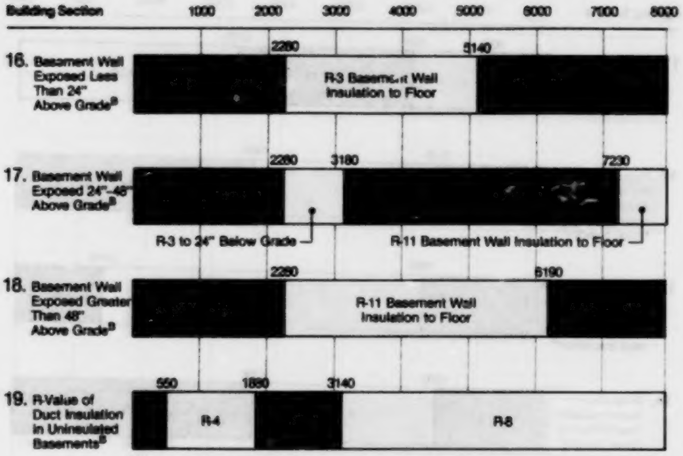
Energy Index[A]



11. A. EI = HI (CI not considered)
    B. Insulation installed vertically, or vertically and under slab (24" total). See Table D on page 17.
12. A. EI = HI (CI not considered)
    B. Applies to crawl spaces with no ventilation or with closeable louvers. Insulation installed vertically on perimeter wall and horizontally 24" over crawl space floor.
13. A. EI = HI + 5.0 CI
    B. Applies to ducts in unvented crawl spaces with no floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table E on page 17.
14. A. EI = HI (CI not considered)
    B. Insulation installed between floor joists with no perimeter crawl space wall insulation.
15. A. EI = HI + 2.0 CI
    B. Applies to ducts in unvented spaces with floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table E on page 17.

Energy Index[A]

[redacted]



16. A. EI = HI (CI not considered)
    B. R-3 based on aluminum foil backed gypsum board on 1" furring installed to about 24" below finish grade.

17. A. EI = HI (CI not considered)
    B. R-3 based on aluminum foil backed gypsum board on 1" furring installed to top of basement floor.

18. A. EI = HI (CI not considered)
    B. R-11 based on blanket insulation between 2" × 3" framing members set-out 1" clear of wall with interior finish installed to top of basement floor.

19. A. EI = HI + 2.0 CI
    B. Applies to ducts in basements with neither wall insulation nor floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table E on page 17.

General Notes:

- EI breakpoints above include corrections for framing members where appropriate.
- R-values of mineral fiber loose fill insulation vary from 2.2 to 2.8 per inch. Corresponding values for cellulose fiber typically vary from 3.4 to 3.7 per inch.
- All R-values shown are based on a mean temperature of 75°F.
- Effective thermal resistances for attic air and roof construction are included in ceiling insulation calculations to determine the Cooling Index adjustment factor.
- Window and door EI breakpoints include an allowance for reduced infiltration when multiple glazing or storm doors are considered.
- Air-conditioning latent load allowance and capacity multiplier are not included in calculations.
- CI adjustment factors shown correspond to heat gains at 95°F with a medium daily range. Adjustment factors for other summer design conditions may be determined using the equations shown in the Appendix, page 28.

Reference Tables

Table A — Blown Ceiling Insulation

Installed R-Value	Approximate In-place Settled Thickness		
	Cellulose	Fiberglass	Rockwool
R-19	5.6"	8.8"	6.5"
R-26	7.6"	12.0"	8.9"
R-30	8.8"	13.0"	10.3"
R-38	11.1"	17.5"	13.0"

* Assumes density and coverage equal to manufacturer's bag label installation specifications.

Caution: Do not specify or purchase blown insulation by inches of thickness. Specify by R-value.

Table B — Rigid Deck Insulation

R-Value of Rigid Deck Insulation	Approximate Insulation Thickness		
	Extruded Polystyrene	Isocyanurate or Polyurethane	Rigid Glass Fiberboard
R-10.0	2"	1-3/8" - 1-1/2"	2-1/2"
R-12.5	2-1/2"	1-3/4" - 1-7/8"	3"
R-15.0	3"	2-1/8" - 2-1/4"	3-1/2"
R-17.5	3-1/2"	2-3/8" - 2-5/8"	4"
R-20.0	4"	2-3/4" - 3"	4-1/2"

Table C — Sheathing Materials

Thickness	R-Value of Sheathing Materials			
	Plywood	Fiber-board	Extruded Poly-styrene	Isocyan-urate
1/2"	R-0.6	R-1.2	R-2.5	R-3.6
3/4"	R-0.94		R-3.8	R-5.4
1"		R-2.1	R-5.0	R-7.2

Table D — Perimeter Insulation

R-Value	Approximate Thickness		
	Extruded Polystyrene	Isocyanurate or Polyurethane	Expanded Polystyrene
R-5.0	1"	3/4"	1-1/2"
R-7.5	1-1/2"	1" - 1-1/4"	2"
R-10.0	2"	1-3/8" - 1-5/8"	2-1/2"

Table E — Duct Insulation

Installed R-Value of Insulation	Approximate Out of Package Insulation Thickness		
	Duct Wrap	Flexible Duct	Rectangular Duct Board
R-4	1-1/2"	1-1/8" - 1-1/4"	1"
R-6	2"	—	1-1/2"
R-8 or Greater	Multiple Layer	—	—

Table F

Selected Values for Structural and Finish Materials, Insulations, Air Spaces, and Surface Films*

Wood bevel siding, 1/2" × 8", lapped	R-0.81
Wood siding shingles, 16", 7½" exposure	R-0.87
Asbestos-cement shingles	R-0.03
Stucco, per inch	R-0.20
Building paper	R-0.06
1/2" nail-base insul. board sheathing	R-1.14
1/2" insul. board sheathing, regular density	R-1.32
25/32" insul. board sheathing, regular density	R-2.06
1/4" plywood (Douglas fir)	R-0.31
3/8" plywood (Douglas fir)	R-0.47
1/2" plywood (Douglas fir)	R-0.62
5/8" plywood (Douglas fir)	R-0.77
1/4" hardboard	R-0.25
Softwood, per inch	R-1.25
Softwood board, 3/4" thick	R-0.94
Vapor barrier — plastic film	R-negl

Concrete blocks, three oval cores

Cinder aggregate, 4" thick	R-1.11
Cinder aggregate, 12" thick	R-1.89
Cinder aggregate, 8" thick	R-1.72
Sand and gravel aggregate, 8" thick	R-1.11
Lightweight aggregate, (expanded clay, shale, slag, pumice, etc.), 8" thick	R-2.00

Concrete blocks, two rectangular cores

Sand and gravel aggregate, 8" thick	R-1.04
Lightweight aggregate, 8" thick	R-2.18
Common brick, per inch	R-0.20
Face brick, per inch	R-0.11
Sand-and-gravel concrete, per inch	R-0.08
Sand-and-gravel concrete, 8" thick	R-0.64
1/2" gypsumboard	R-0.45
5/8" gypsumboard	R-0.56
1/2" lightweight-aggregate gypsum plaster	R-0.32
25/32" hardwood finish flooring	R-0.68
Asphalt, linoleum, vinyl, or rubber floor tile	R-0.05
Carpet and fibrous pad	R-2.08
Carpet and foam rubber pad	R-1.23
Asphalt roof shingles	R-0.44
Wood roof shingles	R-0.94
3/8" built-up roof	R-0.33

Glass

Single glass (winter)	U = 1.10
Single glass (summer)	U = 1.04
Insulating glass (double)	
1/4" air space (winter)	U = 0.58
1/4" air space (summer)	U = 0.61
1/2" air space (winter)	U = 0.49
1/2" air space (summer)	U = 0.56
Insulated glass (triple)	
1/2" air space (winter)	U = 0.39
1/4" air space (summer)	U = 0.4[illegible]
Storm Windows	
1" to 4" air space (winter)	U = 0.50
1" to 4" air space (summer)	U = 0.50

Insulation Batt and Blanket

2" - 2-3/4" thick	R-7.00
3" - 3-1/2" thick	R-11.00
3-1/2" - 6-1/2" thick	R-19.00
Approx. 8.5" thick	R-30.00

Air Spaces (3/4")

Heat flow up	
Nonreflective	R-0.87
Reflective, one surface	R-2.23
Heat flow down	
Nonreflective	R-1.02
Reflective, one surface	R-3.55
Heat flow horizontal	
Nonreflective (also same for 4" thickness)	R-1.01
Reflective, one surface	R-3.48

Note: The addition of a second reflective surface facing the first reflective surface increases thermal resistance values of an air space only 4 to 7 percent.

Surface Air Films

Inside (still air)	
Heat flow up (through horizontal surface)	
Nonreflective	R-0.61
Reflective	R-1.32
Heat flow down (through horizontal surface)	
Nonreflective	R-0.92
Reflective	R-4.55
Heat flow horizontal (through vertical surface	
Nonreflective	R-0.68
Outside	
Heat flow any direction, surface any position	
15 mph wind (winter)	R-0.17
7.5 mph wind (summer)	R-0.25

Example Calculations

Wall Construction	Uninsulated Wall Resistance	Insulated Wall Resistance
Outside surface (film), 15 mph wind	0.17	0.17
Wood bevel siding, lapped	0.81	0.81
½" ins. bd. sheathing, reg. density	1.32	1.32
3½" air space	1.01	
R-11 insulation		11.00
½" gypsumboard	0.45	0.45
Inside surface (film)	0.68	0.68
Totals	4.44	14.43

For uninsulated wall, $U = \frac{1}{R} = \frac{1}{4.44} = U = 0.22$

Therefore, heat loss for the above uninsulated wall section at a + 10°F outside design temperature is equal to 0.22 × 60 (or 70–10) equals 13.2 Btuh per sq. ft. of wall section.

For insulated wall, $U = \frac{1}{R} = \frac{1}{14.43} = U = 0.07$

Therefore, heat loss for the above insulated wall section at a + 10°F outside design temperature is equal to 0.07 × 60 (or 70–10) equals 4.2 Btuh per sq. ft of wall section.

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*Additional resistance values can be obtained from *ASHRAE Handbook of Fundamentals* published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1977.

Degree Days and Cooling Hours for Cities

If your city is not listed here, consult your local weather service or select the nearest city with similar climatic conditions.

Location	Heating Degree Days	Annual Cooling Hours
Alabama		
Birmingham	2710	1430
Huntsville	3190	1290
Mobile	1620	1690
Montgomery	2250	1610
Alaska		
Anchorage	10860	40
Fairbanks	14290	190
Arizona		
Flagstaff	7290	540
Phoenix	1680	2010
Tucson	1730	1790
Arkansas		
Fayetteville	3840	1320
Little Rock	3170	1440
Pine Bluff	2600	1490
California		
Bakersfield	2150	1420
Fresno	2610	1180
Los Angeles	1980	530
Redding	4000	890
Sacramento	2700	850
Santa Ana	1670	660
San Bernardino	1690	1450
San Diego	1500	620
San Francisco	3040	180
San Jose	2410	460
Stockton	2760	960
Colorado		
Boulder	5540	700
Colorado Springs	6410	660
Denver	6150	750
Grand Junction	5680	870
Connecticut		
Hartford	6170	630
New Haven	5890	790
New London	5920	690
Stamford	5460	690
Waterbury	5630	640
Delaware		
Wilmington	4600	860
District of Columbia	4240	1080
Florida		
Fort Myers	410	3180
Gainesville	730	2120
Jacksonville	1230	2040
Lakeland	660	2370
Miami	200	3250
Orlando	720	2340
Tallahassee	1530	1720
Tampa	700	2420
West Palm Beach	270	2940
Georgia		
Atlanta	2980	1330
Augusta	2400	1480
Columbus	2380	1540
Savannah	1820	1600
Valdosta	1520	1760
Hawaii		
Hilo	0	2850
Honolulu	0	3850
Idaho		
Boise	5830	680
Coeur D'Alene	6860	480
Idaho Falls	7890	490
Pocatello	7030	640
Illinois		
Carbondale	4090	1210
Evanston	6640	700
Peoria	6070	820
Rockford	6840	690
Springfield	5530	1010
So. Suburban Chicago	6160	790
Indiana		
Fort Wayne	6220	790
Indianapolis	5630	870
South Bend	6460	720
Terre Haute	5360	930
Iowa		
Cedar Rapids	6600	730
Davenport	6090	820
Des Moines	6610	810
Fort Dodge	7070	740
Mason City	7790	660
Sioux City	6960	800
Kansas		
Salina	4960	1010
Topeka	5210	1030
Wichita	4640	1090
Kentucky		
Lexington	4760	1000
Louisville	4610	1150
Owensboro	4200	1130
Paducah	3650	1250

Location	Heating Degree Days	Annual Cooling Hours
Louisiana		
Baton Rouge	1610	1900
Shreveport	2180	1640
New Orleans	1400	2090
Maine		
Bangor	8220	360
Portland	7570	380
Maryland		
Baltimore	4580	970
Cumberland	5070	730
Frederick	5030	850
Salisbury	4320	970
Massachusetts		
Boston	5630	660
Hyannis	5400	490
Pittsfield	7580	570
Springfield	5840	650
Worcester	6970	540
Michigan		
Detroit	6290	710
Flint	7200	580
Grand Rapids	6890	640
Kalamazoo	6860	680
Lansing	6940	610
Traverse City	7700	530
Minnesota		
Duluth	9690	310
Minneapolis	8250	640
Mississippi		
Greenville	2580	1600
Jackson	2280	1820
Meridian	2340	1610
Vicksburg	2040	1700
Missouri		
Jefferson City	4630	1020
Kansas City	4750	1110
Saint Joseph	5440	1050
Saint Louis	4880	1140
Montana		
Billings	7190	580
Butte	9730	530
Helena	8190	500
Missoula	8000	440
Nebraska		
Grand Island	6440	820
Lincoln	6030	820
North Platte	6680	750
Omaha	6290	860
Nevada		
Las Vegas	2610	1780
Reno	6190	700
New Hampshire		
Concord	7380	610
Manchester	7100	610
New Jersey		
Atlantic City	4850	830
New Brunswick	5400	820
Newark	4900	840
Paterson	5380	780
Summit	5010	780
Trenton	4980	770
New Mexico		
Albuquerque	4350	1120
Santa Fe	6120	720
New York		
Albany	6900	600
Binghampton	7340	460
Buffalo	6960	610
Elmira	6410	530
Hicksville	5550	770
New York	4900	850
Plattsburgh	7900	500
Poughkeepsie	5820	720
Riverhead	5620	770
Rochester	6700	590
Schenectady	6780	600
Syracuse	6720	630
Utica	7200	620
White Plains	5800	860
North Carolina		
Asheville	4130	1050
Charlotte	3200	1250
Fayetteville	3080	1280
Florence	2480	1450
Greensboro	3810	1090
Raleigh	3440	1190
North Dakota		
Bismarck	8860	560
Fargo	9250	580
Grand Forks	9930	580
Ohio		
Akron	6140	670
Bowling Green	4290	1080
Cincinnati	4830	970
Cleveland	6200	740
Columbus	5670	690
Dayton	5620	940
Springfield	5290	920
Toledo	6430	690
Youngstown	6370	630
Oklahoma		
Oklahoma City	3700	1240
Tulsa	3730	1310

Location	Heating Degree Days	Annual Cooling Hours
Oregon		
Pendleton	5190	620
Portland	4700	340
Pennsylvania		
Allentown	5820	740
Erie	6540	680
Greensburg	5800	710
Harrisburg	5280	880
Philadelphia	4980	920
Pittsburgh	5950	720
Scranton	6160	630
York	5450	800
Puerto Rico		
San Juan	0	630
Rhode Island		
Providence	5950	690
South Carolina		
Charleston	2070	1530
Columbia	2520	1460
Spartanburg	3070	1230
South Dakota		
Rapid City	7370	880
Sioux Falls	7840	730
Tennessee		
Chattanooga	3380	1220
Knoxville	3610	1210
Memphis	3210	1430
Nashville	3610	1210
Texas		
Amarillo	4140	1130
Austin	1720	1860
Corpus Christi	930	2530
Dallas	2320	1820
El Paso	2680	1620
Fort Worth	2380	1700
Houston	1410	2080
Lubbock	3570	1270
McAllen	600	2810
San Antonio	1560	1980
Texarkana	2530	1520
Wichita Falls	2900	1570
Waco	2040	1780
Utah		
Ogden	5850	760
Salt Lake City	5980	820
Vermont		
Burlington	8030	520
Rutland	7440	580
Virginia		
Fredericksburg	4240	1090
Norfolk	3440	1150
Richmond	3910	1080
Roanoke	4150	990
Washington		
Seattle	5190	200
Spokane	6770	490
Yakima	5950	580
West Virginia		
Charleston	4510	1010
Huntington	4340	960
Morgantown	5100	680
Wisconsin		
Eau Claire	7970	510
Green Bay	8100	470
La Crosse	7530	610
Madison	7720	640
Milwaukee	7470	570
Wyoming		
Casper	7510	640
Cheyenne	7370	510

Discussion of Adaptability of National Guidelines

Since EI breakpoints vary widely within each ECT, the user should examine each bar graph appropriate to the construction to estimate how closely each current or proposed level of performance of an ECT matches the guideline shown. Selection of a higher performance level than the level indicated by the local EI, e.g., moving from R-19 to R-30, will result in a significantly greater time-to-recoup investment than 7 years. Similarly, selection of a lower performance level will result in a significantly lesser time-to-recoup investment period than 7 years.

By selecting performance levels as close to those indicated by the local EI as practical, the result will be a balanced package of ECTs with reasonably equal payback periods. Where local acceptable practice deviates substantially from the guideline for a specific ECT, an overall balance may be obtained by adjusting one or more of the other ECTs, either higher or lower in thermal performance level, to compensate for the deviation.

These guidelines were developed at the request of the NAHB Special Committee on Energy, by the NAHB Research Foundation, Inc., with the cooperation of the NAHB Technical Services Department, in the public interest to aid builders and consumers. Adherence or nonadherence to these guidelines is, of course, entirely voluntary as a matter of the individual discretion of both members and nonmembers of NAHB. They are presented without intent to involve in any way patents, articles, materials, or processes. NAHB and NAHB Research Foundation, Inc., assumes no liability to any patent owner, nor do they assume any obligation whatever to parties who do or do not adhere to these guidelines.

Appendix

Additional Energy Conserving Techniques

Infiltration

The importance of reducing air-infiltration cannot be overstressed. The amount of glass area and the quality of windows and doors greatly influences the amount of air-infiltration. Poorly fitted windows and doors, not weatherstripped, can negate much of the benefit derived from extra insulation and other energy conserving techniques.

Minimize the use of exhaust fans in cold climates and consider using fans with dampers that close tightly.

Consider

- Sill sealer between the top of the foundation and the band joist or sill plate.
- Sill sealer or caulking between the bottom exterior wall plate and floor sheathing or slab.
- A 1 × 4 for the bottom wall plate rather than a 2 × 4 as shown in the Research Foundation's *Manual of Lumber and Plywood Saving Techniques* (See Suggested Reading List, page 32).
- Caulking cracks around doors, windows, and other openings or penetrations of the walls and at corners.
- Higher grades of caulking. They are more cost-effective since labor remains constant. Latex, acrylic, butyl rubber, and chloro-sulfonated polyethylene caulks are intermediate performance types while high performance categories include polysulfide, polyurethane, and silicone.
- Nailing sheathing tightly to the framing.
- Replacement of wall sheathing damaged during construction.
- Ductless kitchen and bathroom fans.

Insulation Application

Careful attention to the proper installation of insulation reduces heat loss and heat gain. Proper installation includes making sure that:

- When eave vents are used, clearance at the outside plate is left between the top of the insulation and the underside of the roof sheathing.
- Insulation blankets butt snugly where they meet.
- Separate pieces of blanket are applied and snugly butted at framing offsets.
- Blankets are adequately stapled to eliminate gaps between the insulation and framing members.
- Areas between rough framing and door and window heads, jambs and sills are filled with insulation.
- Band joists are insulated to the level shown for frame walls.
- Rips and tears in vapor barriers are repaired. (Vapor barriers in ceilings, walls, and floors should face the heated-in-winter side of the home.)

Additional information on application, loose fill insulation, and other relevant insulation facts may be found in the *Insulation Manual—Homes/Apartments.* (See Suggested Reading List, page 32).

Mechanical/Electrical Equipment

Clock Thermostat

The installation of a clock thermostat to reduce temperatures at night can result in significant energy savings that vary by type of heating system and geographic location.

Temperature setback is usually not recommended in most climates when a heat pump is used.

Water Heater

The water heater is usually the second largest energy user in the home. Locate it as near as possible to the point of greatest use. Investigate the availability of more energy efficient water heaters. Make sure that the temperature setting is as low as practicable (120°F to 125°F). Suggest to the purchaser that it be left at that setting.

Mechanical/Electrical Equipment

Mechanical equipment should be properly sized. Oversizing costs more, uses more energy, is less efficient and produces lower comfort levels. When selecting appliances and mechanical/electrical equipment, consider the comparative energy efficiency of each. The energy efficiency ratio (EER) is a commonly used efficiency rating method for air-conditioning. The higher the EER, the greater the energy savings. Until recently, the typical EER for residential equipment was in the 6 to 7 range. Now, equipment having an EER in the 7 to 8 range is common. Some equipment is available with an EER of 9 or slightly higher.

When using electric heat, consider using the heat pump. The seasonal performance factor (SPF) for a heat pump is greater than electric resistance heat and therefore results in lower operating costs in most areas of the country. In areas of both hot and cold climate extremes, consult the local power company for advice on the merits of heat pump use.

Several newer mechanical/electrical devices to conserve energy are becoming available. These include: automatic stack dampers that close the flue when the furnace is off; intermittent ignition devices for gas furnaces and ranges; heat exchangers to capture waste heat from air-conditioners to heat water; and solar water heating or space heating systems in areas where they are justifiable.

Duct System

Avoid running ducts through nonconditioned spaces. If this is not possible, then insulate the ducts in accordance with the guidelines. Avoid undersizing duct work. Use of more efficient fittings and minimizing turns increases system efficiency. To reduce duct leakage, keep duct runs short and insure that all joints are properly taped. Tape joints in metal ducts even if they are to be covered with insulation. As the thermal efficiency of the envelope improves, simpler, lower-cost duct systems become possible.

Construction Techniques

Foundation

Extra supervision to assure that the top of foundation or slab is square and level will reduce air-infiltration and save labor framing and trim time. Construction practices to minimize air-infiltration will require the same kind of supervision and detailed attention to cracks and spaces around wires, pipes, and ducts necessary to attain good acoustical performance.

Framing

Eliminating unnecessary framing members in floors, ceilings, and exterior walls will help reduce heat loss and heat gain. Twenty-four inch on center framing, 2-stud corners, drywall back-up clips at partition intersections, and the use of plywood box headers filled with insulation are examples of methods that will reduce heat flow through framing members. For details of other lumber saving techniques, see the NAHB *Manual of Lumber and Plywood Techniques* (See Suggested Reading List, page 32).

Design

House Shape

Energy use can be reduced by lowering the ratio of exterior wall area to floor area. H, T, and L shaped homes have higher ratios of exterior wall area to floor area than rectangular homes with the same floor area. Reducing the ceiling height from 8' to 7'6" conserves energy.

Orientation and Shading

When possible, orienting homes with the ridge running east to west, rather than north to south, is more advantageous. Shading south facing glass with the proper overhang reduces heat gain in winter. Minimize glass areas on east and west walls. Where feasible in cold climates, put attached garages or carports on the north, northeast, or northwest. In hot climates put attached garages or carports on the east or west side when feasible. In hot climates, tinted or reflective east/west glass can significantly reduce heat gain.

Fireplace

Fireplaces improperly designed and constructed result in significant heat loss. Tight fitting dampers reduce heat loss when the fireplace is not in use as do glass doors. Where practical, supplying outside air to the firebox will reduce heat loss from the home and improve performance. Also, consider devices for heat recovery and recirculation of air for conventional fireplaces. The new generation of prefabricated fireplaces includes dampers, glass doors, outside air ducts to the firebox, and hot-air circulation systems.

Attic Ventilation

Adequate natural ventilation of the attic space is important to reduce summer air temperatures. It also serves to allow moisture vapor to escape and thereby minimize the chance for wintertime condensation.

Technical Terms

The technical terms necessary to determine local heating and cooling indices are as follows.

Heating Degree Days

The number of Heating Degree Days in a day is the average of the high and low temperature of that day subtracted from 65°F. For example, if the high for the day is 60°F and the low is 30°F, 20 degree days are in that day, i.e.,

$$65 - \frac{(60 + 30)}{2} = 20.$$

Degree days for the year are the sum of the daily degree days and are used as a measure of energy consumption for space heating. Degree days for 270 cities are shown in this manual.

Heating Cost per 100,000 BTU

— Natural gas; \$/100,000 Btu = \$/Therm.

— Fuel oil; $\$/100,000\ \text{Btu} = \frac{\$/\text{Gallon} \times 100,000}{\text{Btu value/gallon}}$

— Electricity; \$/100,000 Btu = \$/Kwh × 29.3

Accurate determination of local energy costs is extremely important in determining local heating and cooling indices.

Seasonal Heating Efficiency

The seasonal efficiency of a heating system will vary depending on fuel type, equipment type, distribution system, and geographical location. The *ASHRAE 1976 Systems Handbook* cites effective seasonal efficiencies from 0.50 to 0.78 for natural gas and 0.44 to 0.69 for fuel oil, with 40 percent furnace oversizing. For direct electric heating systems, corresponding efficiencies from 0.77 to 1.20 are shown, with 10 percent equipment oversizing. The higher values apply to cold climates while the lower values apply to mild climates. In the absence of specific local information, it is suggested that the following seasonal efficiencies be used:

Natural Gas	0.60
Fuel Oil	0.50
Direct Electric	1.00

Winter performance of heat pump systems will vary even more widely. See your local power supplier for the heat pump seasonal performance factors (SPF).

The importance of using reliable local data for heating cost per 100,000 Btu and seasonal heating efficiencies cannot be overemphasized.

Summer Cooling Hours

The summer cooling hours represent the number of equivalent full load operating hours per year that the air-conditioning equipment operates. The number of hours in the entire cooling season is greater than the summer cooling hours shown because of intermittent operation of the air-conditioning equipment under partial load. Cooling hours for 270 cities are shown in this manual.

Energy Efficiency Ratio (EER)

The energy efficient ratio of air-conditioning equipment is the Btuh output divided by the watt input (Btuh/watt). The higher the EER, the more efficient the equipment and, under identical conditions, the lower the electrical consumption for air-conditioning.

Definition of Heating and Cooling Indices

Heating Index (HI)

The heating index is defined as:

$$\text{HI} = \frac{(\text{Degree Days})\ (\$/100,000\ \text{Btu})}{\text{Seasonal Heating Efficiency}}$$

Cooling Index (CI)

The cooling index for an individual apartment cooling system is defined as:

$$\text{CI} = \frac{(\text{Summer Cooling Hours})\ (\$/\text{Kwh})\ (100)}{\text{EER}}$$

Calculation of Energy Index Breakpoints (EIB)

The elements necessary to determine Energy Index Breakpoints are as follows:

Buyer Cost of Improvement

Estimate additional first cost to the owner of a higher performance level of an (ECT) such as additional insulation, storm windows, etc. If additional construction costs are necessitated because of the improvement, such costs must be converted to owner costs and included. All costs should be related to the appropriate area or length involved.

Energy Index Breakpoint

A convenient area for calculation purposes is 1000 square feet for opaque building sections, 100 square feet for windows, actual area for patio and opaque doors and 100 linear feet for duct systems and perimeter slab edges.

Present Worth Factor (PWF) with Rising Energy Cost

First year energy savings (S) are multiplied by the appropriate PWF to estimate the present worth of the sum of the energy savings over a time period (n), with energy price increasing at an annual percentage rate (f). At an alternate investment interest rate (i) of 9 percent, some Present Worth Factors are as follows:

f = rate of increase in energy cost	Time Period (n)					
	3	5	7	10	15	20
15	3.34	5.89	8.72	13.59	23.85	36.81
12	3.17	5.43	7.81	11.85	18.77	26.92
11	3.11	5.28	7.53	11.07	17.40	24.34
10	3.06	5.14	7.26	10.52	16.15	22.04
9	3.00	5.00	7.00	10.00	15.00	20.00
8	2.95	4.86	6.75	9.51	13.94	18.16
7	2.89	4.73	6.50	9.04	12.96	16.56
6	2.83	4.60	6.27	8.60	12.06	15.11

*Refer to page 29 for other interest rates.

Change in Heat Loss/°F

This is usually a change in the overall coefficient of heat transmission (U-value) of a building section. For storm windows and doors, the thermal improvement (change in U-value) may be increased by adding the effect of reduced infiltration to the change in U-value. The change in thermal improvement should be reduced for an area at an intermediate temperature, such as a basement or an unvented crawl space. The guidelines include these adjustments.

Change in Heat Gain

Use the appropriate equivalent temperature difference at outside summer design temperature conditions. The guidelines are based on a 95°F temperature combined with a medium daily range that is applicable to a large portion of the country having a high percentage of homes equipped with central air-conditioning systems.

Calculation Procedures

The EIB necessary to justify a given level of thermal improvement is found as follows:

For homes with heating and no air-conditioning:

$$\text{EIB} = \text{HIB} = \frac{(\text{Owner Cost of ECT})(100{,}000)}{(\text{PWF})(\text{Change in Heat Loss}/°\text{F})(\text{Area or Length})(24)}$$

For homes with air-conditioning and no heating:

$$\text{EIB} = \text{CIB} = \frac{(\text{Owner cost of ECT})(100{,}000)}{(\text{PWF})(\text{Change in Heat Gain/Sq. Ft.})(\text{Area})}\ (r)$$

For homes with heating and air-conditioning:

$\text{EIB} = \text{HIB} + (r)(\text{CIB})$, where:

r = An adjustment factor, applied to the cooling index only, accounts for radiation and other effects on various building sections. Suggested adjustment factors for each ECT shown are noted directly under each page of appropriate bar graphs in the guidelines. A precise adjustment factor for any improvement may be found by calculating the local HIB and CIB required to justify the improvement and dividing the heating figure by the cooling figure as shown in following example.

An Example of How to Determine Local EI Breakpoints

Calculate the EIB for R-38 versus R-30 ceiling insulation in a truss framed structure at a buyer cost difference of $80.00 per thousand square feet.

Using methods shown in the 1977 *ASHRAE Handbook of Fundamentals*, a reduction of 0.007 in U–value has been calculated. A 7–year period (n) with a 12 percent increase in annual energy cost (f) and a 9 percent alternate investment rate (i) is used in this example. The breakpoint for justifying the thermal improvement on the basis of heating savings only is calculated as follows:

$$\text{EIB} = \text{HIB} = \frac{(\text{Buyer cost of ECT})(100{,}000)}{(\text{PWF})(\text{Change in Heat Loss}/{}^{\circ}\text{F})(\text{Area of Length})(24)}$$

$$\text{EIB} = \text{HIB} = \frac{(80.00)(100{,}000)}{(7.81)(0.007)(1000)(24)} = 6097$$

Similarly, the 1977 *ASHRAE Handbook of Fundamentals* method was used to obtain the reduction of heat gain. The method requires the addition of roof color and climate zone to obtain the information. In the example the structure is in Climate Zone C and the roof is a light color. The calculated heat gain reduction is .205. This number can be calculated from the table for Climate Zone C in the 2nd Edition of the *Insulation Manual* by dividing the difference in heat gain for the two ECTs by 1.3 to account for the fact that the latent load is unchanged. The breakpoint for justifying the thermal improvement on the basis of cooling savings only is calculated as follows:

$$\text{EIB} = \text{CIB} = \frac{(\text{Buyer cost of ECT})(100{,}000)}{(\text{PWF})(\text{Change in Heat Gain/Sq. Ft.})(\text{Area})}$$

$$\text{EIB} = \text{CIB} = \frac{(80.00)(100{,}000)}{(7.81)(0.205)(1000)} = 4997$$

Either breakpoint equally justifies the investment. When both heating and cooling are considered the indices should be combined utilizing an adjustment factor (r). Average "r" factors for each ECT are shown underneath each corresponding bar graph. In this example, since HIB and CIB are known, the actual "r" factor can be determined as follows:

$$\text{EIB} = \text{HIB} + (r)(\text{CIB})$$

$$r = \frac{\text{HIB}}{\text{CIB}} = \frac{6097}{4997} = 1.22$$

Correspondingly, whenever the local HI + (1.22)CI equals or exceeds 6097, the initial investment under the economic assumptions is in order. Thus:

If HI = 4500 and CI = 1500,
EI = 4500 + (1.22)(1500)
= 6330 (Investment justified)

If HI = 2500 and CI = 2000,
EI = 2500 + (1.22)(2000)
= 4940 (Investment not justified)

Analyses of a similar nature may be made locally for any level of thermal improvement for opaque building sections, windows, doors, and duct systems. It may be noted that if a 12 percent annual increase in energy cost and a 10 year time period were utilized at the same interest rate, the PWF would be 11.65 and the value of 6097 would be reduced.

Whenever HI + (1.22)CI equals or exceeds $\frac{(7.81)}{(11.65)}(6097)$ = 4087, the investment is justified under those economic assumptions. Some available references on engineering economics are shown in the Suggested Reading List.

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* To make the PWF method practical, some simplifying assumptions have been made that do not materially effect the results. Salvage value is not included because most depreciating residential items, like mechanical/electrical equipment or devices, have essentially zero value. For most other ECT's, the salvage value is greater at the end of the period of analysis than its first cost due to the home's appreciation in value (within reasonable time limits). Thus, use of salvage value for such ECT's would justify an unlimited added first cost expenditure. Operating and maintenance costs are ignored because they are zero for most ECT's, except for mechanical/electrical equipment and devices. The added cost of insurance is ignored because it is relatively minor. The effect of added real estate taxes, due to the increased first cost of the added ECT and the effect of the income tax in reducing the added cost of mortgage interest for that added first cost, are omitted because they are minor and tend to offset each other.

Present Worth Factors and Time to Recoup Investment

A PWF equivalent to a 7-year period for time to recoup investment has been used for determining Energy Index Breakpoints (EIB).

The general formula for PWF may be modified to provide for different rates of cost increases for energy and for mortgage or alternative investment interest rates as follows:

$P = S\left[\frac{a(a - 1)}{a - 1}\right]$; where:

P = Present worth or added cost of ECT.

S = Operating cost savings in the first year, attributable to the added ECT.

n = The period of years of analysis or time to recoup investment.

$a = \frac{1 + f}{1 + i}$; where:

f = The estimated annual percentage rate of price increase for the fuel (or energy) used, expressed as a decimal.

i = The alternate investment interest rate expressed as a decimal.

Thus, the time to recoup investment (n) for an ECT can be determined by the following equation:

$$n = \frac{\log\left[\frac{P(a - 1)}{S} + a\right]}{\log a} - 1$$

EIBs for any selected payback period may be calculated by determining the PWF, when S = $1.00, as follows:

$PWF = 1\left[\frac{a(a^n - 1)}{a - 1}\right]$; where:

PWF = Present Worth Factor or added cost of ECT per $1.00 of operating cost savings in the first year, attributable to the change in thermal performance level of the ECT.

Note: The other symbols were previously listed.

For example:

Assume $f = 12\%$, $i = 9\%$, $n = 6$ years

$$a = \frac{1 + f}{1 + i} = \frac{1.12}{1.09} = 1.02752$$

$$PWF = 1\left[\frac{a(a^n - 1)}{a - 1}\right]$$

$$= 1\left[\frac{1.02752(1.02752^6 - 1)}{1.02752 - 1}\right]$$

$$= 1\left[\frac{0.1818}{0.02752}\right] = 6.61$$

Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)

Describe ECT:
Increasing Ceiling Insulation
from R-30 to R-38 in
truss framed structure

Heating Index Breakpoint (HIB)

Line 1. Establish additional owner cost for a given area (or length for slab edge perimeter or duct insulation of ECT) = $ 80.00/MSF
Line 2. Multiply Line 1 x 100,000 = 8,000,000
Line 3. Select appropriate Present Worth Factor (PWF table, page 27) = 7.81
Line 4. Enter change in heat loss/°F (see discussion, page 27) per unit area or length = 0.007
Line 5. Enter area or length used in Line 1 = 1000 S.F.
Line 6. Multiply Line 3 x Line 4 x Line 5 x 24 = 1312.08

HI Breakpoint = $\frac{\text{Line 2}}{\text{Line 6}} = \frac{8{,}000{,}000}{1312.08} = \boxed{6097}$

Cooling Index Breakpoint (CIB)

Line 7. Enter Line 2 from above = 8,000,000
Line 8. Enter PWF from Line 3 above = 7.81
Line 9. Enter change in heat gain (see discussion, page 27) per unit length or area = 0.205
Line 10. Enter area or length from line 5 above = 1000 S.F.
Line 11. Multiply Line 8 x Line 9 x Line 10 = 1601.05

CI Breakpoint = $\frac{\text{Line 7}}{\text{Line 11}} = \boxed{4997}$

Adjustment Factor (r):

Adjustment Factor (r) = $\frac{\text{HIB}}{\text{CIB}} = \frac{6097}{4997} = 1.22$

Line 12. Energy Index Breakpoint (EIB) = HIB or (r) (CIB) = 6097

Line 13. Local EI = $\frac{4500}{\text{Local HI}} + \frac{(1.22)\ (1500)}{\text{(r) (Local CI)}} = 6330$

If Line 13 is greater than Line 12, the ECT is justified ☒ Yes ☐ No

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Date 10/25/79

Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)

Describe ECT: ______________________

____

____

Heating Index Breakpoint (HIB)

Line 1. Establish additional owner cost for a given area (or length for slab edge perimeter or duct insulation of ECT). . . . . = $ ______
Line 2. Multiply Line 1 x 100,000 . . . . = ______
Line 3. Select appropriate Present Worth Factor (PWF table, page 27) . . . . = ______
Line 4. Enter change in heat loss/°F (see discussion, page 27) per unit area or length . . . . = ______
Line 5. Enter area or length used in Line 1 . . . . = ______
Line 6. Multiply Line 3 x Line 4 x Line 5 x 24 . . . . = ______

Hi Breakpoint = $\frac{\text{Line 2}}{\text{Line 6}}$ = ______ = ☐

Cooling Index Breakpoint (CIB)

Line 7. Enter Line 2 from above . . . . = ______
Line 8. Enter PWF from Line 3 above . . . . = ______
Line 9. Enter change in heat gain (see discussion, page 27) per unit length or area . . . . = ______
Line 10. Enter area or length from line 5 above . . . . = ______
Line 11. Multiply Line 8 x Line 9 x Line 10 . . . . = ______

CI Breakpoint = $\frac{\text{Line 7}}{\text{Line 11}}$ = ______ = ☐

Adjustment Factor (r):

Adjustment Factor (r) = $\frac{\text{HIB}}{\text{CIB}}$ = ______ = ______

Line 12. Energy Index Breakpoint (EIB) = HIB or (r) (CIB) . . . . = ______

Line 13. Local EI = $\underset{\text{Local HI}}{\rule{2cm}{0.4pt}} + \frac{(\qquad)\ (\qquad)}{\text{(r) (Local CI)}}$ = ______

If Line 13 is greater than Line 12, the ECT is justified ☐ Yes ☐ No

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Date ______________

Suggested Reading List

ASHRAE Handbook of Fundamentals — 1977

ASHRAE Handbook — 1976 Systems
Available from American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
345 East 47 Street
New York, N.Y. 10017

Energy Conservation in Buildings: Techniques for Economical Design
Griffin, C. W., 1974.
Available from Construction Specifications Institute
1150 17th Street, N.W.
Washington, D.C. 20036

Insulation Manual — Homes/Apartments
Available from NAHB Research Foundation, Inc.
P.O. Box 1627
Rockville, MD 20850

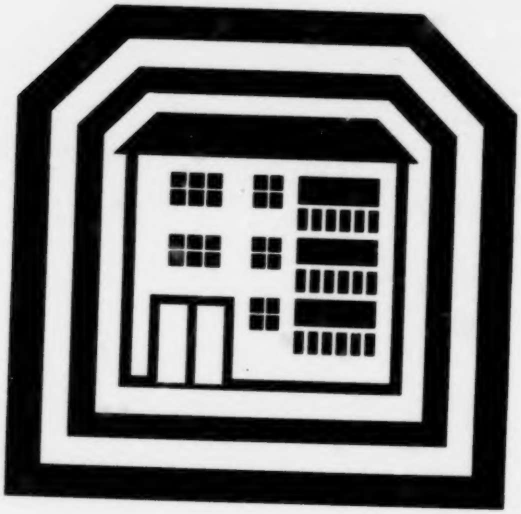
Manual of Lumber and Plywood Saving Techniques
Available from NAHB Research Foundation, Inc.
P.O. Box 1627
Rockville, MD 20850

Principles of Engineering Economy
Grant, Eugene L.; Ireson, W. Grant; and Leavenworth, Richard S., 1976.
Ronald Press Co.
New York, N.Y.

NAHB Thermal Performance Guidelines

Apartments and Condominiums

The National Association of Home Builders
15th and M Streets, N.W.
Washington, D.C. 20005



Foreword

The thermal performance guidelines presented in this manual are practical, comprehensive, and flexible. Based on sound engineering and economic practice, they permit a builder to select a balanced and cost effective energy conserving package which will assure the apartment or condominium owner economic benefits and living comfort while reducing the consumption of valuable energy resources. They must be considered a most important contribution to the home building industry and to the people of the United States.

The guidelines in this manual were developed for NAHB by its wholly owned subsidiary, the NAHB Research Foundation, working with the association's technical staff—under the guidance of the NAHB Special Committee on Energy headed by Chairman Ivan Wohlworth of Hicksville, New York, and Vice Chairman Jack Demetree of Jacksonville, Florida.

Introduction

The ability to utilize techniques contained in this manual is important. With the many and varied recommendations on how much energy to save, and how much insulation to specify, or which energy conserving techniques to utilize, a clear, concise, and unbiased method of making cost-effective decisions is needed. Groups, on one extreme, are pressing for saving the maximum amount of energy. Other groups are interested in causing the least disruption to "business as usual." The techniques in this manual provide a proper and necessary balance in our Nation between saving energy and economic benefit. NAHB recommends that all persons keep clearly in mind that benefits must relate to costs in a reasonable way. While energy saving is vitally important to our Nation's future, the price that we pay to save energy cannot be ignored.

The members of NAHB, recognizing the importance of energy conservation in buildings, have in the past years developed and applied construction practices and utilized materials that have contributed greatly to increased energy efficiency in the homes, apartments, and other structures they have built. NAHB has pledged to continue to incorporate into all newly constructed homes, apartments, and commercial buildings the energy efficient techniques necessary to alleviate rapidly increasing heating and cooling costs.

As part of the Association's ongoing service to members and as part of its share in helping reduce energy consumption in this country, these NAHB Thermal Performance Guidelines for Apartments and Condominiums have been developed.

The procedures described in this manual have a simple purpose—to help the builder conserve energy in a cost-effective manner. By taking the time to understand the steps outlined in this manual, the builder can take advantage of the best engineering and economic judgments of the NAHB Research Foundation, NAHB's technical staff, and the Special Committee on Energy.

Basic assumptions used in developing these guidelines were:

- Guidelines should be based on performance, NAHB's historic approach; not specification standards.
- Freedom of choice in design should be maintained.
- A procedure that develops a balanced package of energy saving features is necessary.
- The selection of each individual item must be cost-effective.

The guidelines for apartments and condominiums presented in this manual are intended for both low and high rise buildings. While the illustrations are based on a 7-year maximum time-to-recoup investment, the methods of modifying the procedure for other economic assumptions are also included.

By following the procedures in this manual, the builder will be able to market a lower-cost apartment. Total costs will be less and the pressure for rent escalation caused by sharply rising energy prices will be minimized. This is an immediate marketing advantage. If the resident is paying for the cost of energy, the marketing advantage exists because the monthly cost of utilities would be lower.

Additional marketable features realized by following these guidelines include a more comfortable living unit due to reduced drafts and increased inside temperature of exterior walls; better protection from outside noise due to tighter fitting doors and windows, double glazing and insulation; and cleaner apartments due to less air-infiltration.

Resale value of the apartment building will be enhanced as a result of increased thermal performance because the building's competitive position will improve over time as energy prices rise.

Finally, the builder helps conserve the nation's energy supply, which in turn helps reduce our balance of payments deficit and improves the value of the dollar in foreign markets. This tends to improve the general economic climate.

Procedure

How To Use the Bar Charts

The bar charts contained in this manual have been developed using average national costs for each energy conserving technique shown. Specific economic assumptions used in these bar charts are:

- Time-to-recoup investment of 7 years.
- An annual increase in energy cost of 10 percent in current dollars.
- An alternative investment interest rate of 9 percent.

The assumptions result in a Present Worth Factor (PWF) of 7.26. For example, any proposed thermal improvement expected to save $50 per year in energy costs means a maximum of 7.26 times $50 can be spent for the improvement if the decision is to be made on a cost-effective basis.

This manual uses an Energy Index (EI) concept that enables builders to calculate answers on a local basis using their own specific information. Any combination of energy cost increase, interest rate, time-to-recoup investment, or owner cost may be used to calculate a builder's indices. Procedures for this calculation are found on page 36.[1] A number of important techniques that do not lend themselves to the index concept are discussed in a separate section.

The user of this procedure is strongly encouraged to calculate breakpoints on a local basis, using local owner cost and energy cost information. Examples of local breakpoint calculations are shown in the Appendix.

Several examples of how these guidelines can be utilized in the selection of appropriate levels of cost-effective thermal protection are presented on the following pages. Working through these problems will develop the familiarity needed to calculate an EI quickly and easily so that anyone may apply it to a specific construction technique.

Definitions

Heating Index (HI): A measure of the heating cost for a given geographic location.

Cooling Index (CI): A measure of the cooling cost for a given geographic location.

Adjustment Factor (r): A varying number that modifies the cooling index to account for the effects of the sun on different elements of the building.

Energy Index (EI):[2] The sum of the HI and the product of the adjustment factor and the CI, or EI = HI + (r)CI.

Energy Conserving Technique (ECT): Any construction technique that serves to conserve energy.

Energy Index Breakpoints (EIBs): The energy index number that provides exactly a 7-year payback in energy savings for the additional expenditure for the thermal improvement immediately to the right of the breakpoint in the bar chart.

Present Worth Factor (PWF):[3] The number that equals the dollars that can be spent now to save $1 on energy bills during the first year.

Seasonal Heating Efficiency: The seasonal efficiency of a particular type of heating system when it is installed properly and operating under actual conditions.

Energy Efficiency Ratio (EER): The rating of an air-conditioning unit that indicates how efficiently electricity is converted into cooling energy.

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[1] The lowest level of thermal performance for each ECT is that level as required by the HUD Minimum Property Standards, Revision No. 5, for Multifamily Dwellings, dated April 1977.

[2] The EI quantifies the effect on annual energy saving produced by an Energy Conserving Technique (ECT). For an assigned time-to-recoup investment, the EI equates the aggregate savings (for both heating and cooling seasons) to the initial owner cost for a particular ECT.

[3] A table of PWFs for other economic assumptions is included in the Appendix, along with the necessary procedure to calculate Energy Index Breakpoints (EIBs) for any combination of energy cost increase, alternate investment rate, time-to-recoup investment, or owner cost of improvement.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days . . . . = 8250

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 35.) . . . . = $ 0.209

Line 3. Multiply Line 1 × Line 2 . . . . = 1724

Line 4. Estimate seasonal heating efficiency (see discussion, page 35.) . . . . = 0.60

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ = 2874

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours . . . . = ________

Line 6. Enter dollar cost per Kwh for air-conditioning. . . . . = $ ________

Line 7. Multiply, Line 5 × Line 6 × 100 . . . . = ________

Line 8. Estimate seasonal EER of equipment . . . . = ________

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = ☐

Adjustment Factor (r):

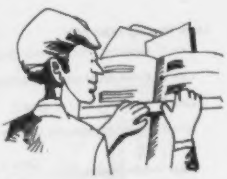
Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the **"Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)"** page 39.

Local Energy Indices (EIs):		HI	+	(r)	CI	=	EI
. . . .	=	2874	+	(1.2)	________	=	2874
Ceilings . . . . Frame Walls . . . . }	=	________	+	(1.0)	________	=	________
Floors Over Open Spaces . . . . Masonry Walls . . . . }	=	________	+	(1.0)	________	=	________
Rigid Roof Docks	=	________	+	(0.6)	________	=	________
Windows and Patio Doors	=	________	+	(___)	________	=	________
Ducts in . . . . (Note: r varies, see appropriate bar graph)							
Perimeter Slab Edges . . . . Floors Over Crawl Spaces . . . . Basement or Crawl Walls . . . . }	=	HI ONLY				=	________
Other (describe) ________________ ________________	=	________	+	(___)	________	=	________

(Date) ________________

Sample Problem One

The Problem: How much blanket ceiling insulation should be used in an apartment building in Minneapolis that is heated by individual apartment heating systems fueled with natural gas?



The Solution: Make a copy of the "Local EIs" worksheet found on page 12. You will need a calculator, pad, ruler, telephone, and a couple of sharp pencils.

Turn to the Degree Days and Cooling Hours list beginning on page 24. The reference for Minneapolis is 8,250. Write that figure here.

2 Call your local natural gas supplier and find out the price of energy for space heating in units of $/100,000 Btu. The supplier will tell that the cost for natural gas at the appropriate step, including various service charges, fuel cost adjustments, surcharges, and taxes, is $0.209/100,000 Btu. Write that figure here.

3 Multiply line 1 by line 2 and enter the answer here.

4 Call your local mechanical engineer or heating contractor to find the seasonal efficiency of your specific heating equipment. If the contractor doesn't answer, you can use the generalized information found on page 35. In this case, the contractor does answer. The seasonal efficiency for gas is 0.60. Write that figure here.

5 Divide line 3 by line 4. In this case, the answer is 2,874. Write that figure here.

Since this problem involved only heating, your local Heating Index (HI) is the only Energy Index (EI) you are concerned with at the moment. Turn to page 13 and find the bar for ceiling insulation. Take your ruler and move along the top of the chart to your HI, 2,874. Make a mark with your pencil and follow the ruler down the page to the ceiling insulation bar. Read your value. In this case it is R-19.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days .... = ________

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 35.)........ = $ ________

Line 3. Multiply Line 1 × Line 2 .... = ________

Line 4. Estimate seasonal heating efficiency (see discussion, page 35.) .... = ________

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ ________ = ☐

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours .... = 3250

Line 6. Enter dollar cost per Kwh for air-conditioning............................ = $ .0484

Line 7. Multiply, Line 5 × Line 6 × 100 .... = 15730

Line 8. Estimate seasonal EER of equipment............................ = 7.0

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = $\boxed{2247}$

Adjustment Factor (r):

Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the **"Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)"** page 39.

Local Energy Indices (EIs): HI + (r) CI = EI

Ceilings .... = ________ + (1.2) 2247 = 2696

Frame Walls .... } = ________ + (1.0) ________ = ________
Floors Over Open Spaces .... }

Masonry Walls .... } = ________ + (1.0) ________ = ________
Rigid Roof Decks .... }

Windows and Patio Doors .... = ________ + (0.8) ________ = ________

Ducts In............................ = ________ + (___) ________ = ________
(Note: r varies, see appropriate bar graph)

Perimeter Slab Edges .... }
Floors Over Crawl Spaces .... } = HI ONLY .... = ________
Basement or Crawl Walls .... }

Other (describe)________________________ = ________ + (___) ________ = ________

____

(Date) ________________

Sample Problem Two

The Problem: How much blanket ceiling insulation is needed for only cooling in Coral Gables, Florida, when individual apartment units and the energy source is electric?

The Solution: As in problem one, you will need your telephone, a copy of the "Local EIs" worksheet, a calculator, a ruler, and pencils.

1 Turn to the Degree Days and Cooling Hours list beginning on page 24. Immediately you will find a new problem. Coral Gables has no entry. If your city is not listed in the tables, you may use the data for the nearest city listed and arrive at a fairly accurate answer. However, for the most accurate results, you are strongly urged to call your local weather service. In this case the weather data of the nearest listed city (Miami) is used. The figure is 3,250. Write the figure here.

2 Call your local electric company and get the price of energy for space cooling in units of $/Kwh. Make sure it includes the various fuel cost adjustments, surcharges, and taxes. In this case, the price is $.0484.

3 Multiply line 5 by line 6 and that answer by 100. Write that figure here.

4 Call your local mechanical engineer or HVAC contractor. Find out the Energy Efficiency Ratio (EER) for your specific equipment. In this case it is 7.0. Write that figure here.

5 Divide line 7 by 8. Write that figure here. This figure is your local Cooling Index (CI).

The CI must be adjusted when determining the EI. The worksheet gives you the proper correction factor. In the case of ceiling insulation, it is listed as (r) = 1.2. The result of multiplying 1.2 by 2,247 is your EI.

Turn to the Energy Index on page 13. Use your ruler and mark off the answer, 2,696. Drop vertically to the bar. The value is R-19.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days = 5550

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 35.) = $ 0.244

Line 3. Multiply Line 1 × Line 2 = 1354

Line 4. Estimate seasonal heating efficiency (see discussion, page 35.) = 0.60

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ = $\boxed{2257}$

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours = 770

Line 6. Enter dollar cost per Kwh for air-conditioning = $ 0.0985

Line 7. Multiply, Line 5 × Line 6 × 100 = 7585

Line 8. Estimate seasonal EER of equipment = 8.0

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = $\boxed{948}$

Adjustment Factor (r):

Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the **"Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)"** page 39.

Local Energy Indices (EIs):

		HI	+	(r)	CI	=	EI
Ceilings	=	2257	+	(1.2)	948	=	3395
Frame Walls Floors Over Open Spaces	=		+	(1.0)		=	
Masonry Walls Rigid Roof Decks	=		+	(1.0)		=	
Windows and Patio Doors	=		+	(0.6)		=	
Ducts In (Note: r varies, see appropriate bar graph)	=		+	(__)		=	
Perimeter Slab Edges Floors Over Crawl Spaces Basement or Crawl Walls	=	HI ONLY				=	
Other (describe) ________	=		+	(__)		=	

(Date) ____________

Sample Problem Three

The Problem: How much blanket ceiling insulation is required in Hicksville, N.Y., for both heating and cooling? Individual HVAC units will be utilized and natural gas is the heat energy source. Electricity is the cooling energy source.

The Solution:

Although this problem is more complex, the initial steps are identical. The same tools are needed. The heating problem will be solved first.

1 Turn to the Degree Days and Cooling Hours list beginning on page 24. The proper number of degree days is 5,550. Write that figure here.

2 Call the natural gas company and find out the price of energy for space heating in units of $/100,000 Btu. Make sure the unit price used includes the various fuel adjustments, surcharges, and taxes. In New York the price is $0.244/100,000 Btu. Write that figure here.

3 Multiply line 1 by line 2. Write that figure here.

4 Call your local mechanical engineer or heating contractor to find out the seasonal efficiency of your specific heating equipment. If you have to, you may use the seasonal efficiencies found on page 35. For gas, it is 0.60. Write that figure here.

5 Calculate your local HI by dividing line 3 by line 4. The answer is 2,257. Write that figure here.
Now, solve the cooling problem.

6 Turn back to the reference table on page 24. The cooling hours for Hicksville are 770. Write that figure here.

7 Call your electric company and find out the price of energy for space cooling in units of $/Kwh. Make sure the unit price includes the various fuel adjustments, surcharges, and taxes. For Hicksville, it is $0.0985/Kwh. Write that figure here.

8 Multiply line 5 by line 6 and that answer by 100. Write that figure here.

9 Call your local mechanical engineer or electrical contractor to find out the EER for your specific equipment. In this case it is 8.0. Write that figure here.

10 Calculate your local CI by dividing line 7 by line 8. The answer is 948. Write that figure here.

11 Now you are ready for the new part — reconciling the HI and CI. The worksheet gives you the proper correction factor. In the case of ceiling, it is listed as (r) = 1.2. Write the HI from line 5 here. Multiply the CI by 1.2 and add the HI. The result is your EI, 3,395. Write that figure here.

12 Just as before, find 3,395 on the table on page 13. Drop vertically to the ceiling bar. The answer is R-19.

Worksheet to Determine Local Energy Indices (EIs)

Local Heating Index (HI):

Line 1. Determine local winter degree days . . . . = ________

Line 2. Enter dollar cost of heating energy per 100,000 Btu (see page 35.) . . . . = $ ________

Line 3. Multiply Line 1 × Line 2 . . . . = ________

Line 4. Estimate seasonal heating efficiency (see discussion, page 35.) . . . . = ________

Local Heating Index (HI) = $\frac{\text{Line 3}}{\text{Line 4}}$ = ________ = ☐

Local Cooling Index (CI):

Line 5. Determine local summer cooling hours . . . . = ________

Line 6. Enter dollar cost per Kwh for air-conditioning . . . . = $ ________

Line 7. Multiply, Line 5 × Line 6 × 100 . . . . = ________

Line 8. Estimate seasonal EER of equipment . . . . = ________

Local Cooling Index (CI) = $\frac{\text{Line 7}}{\text{Line 8}}$ = ________ = ☐

Adjustment Factor (r):

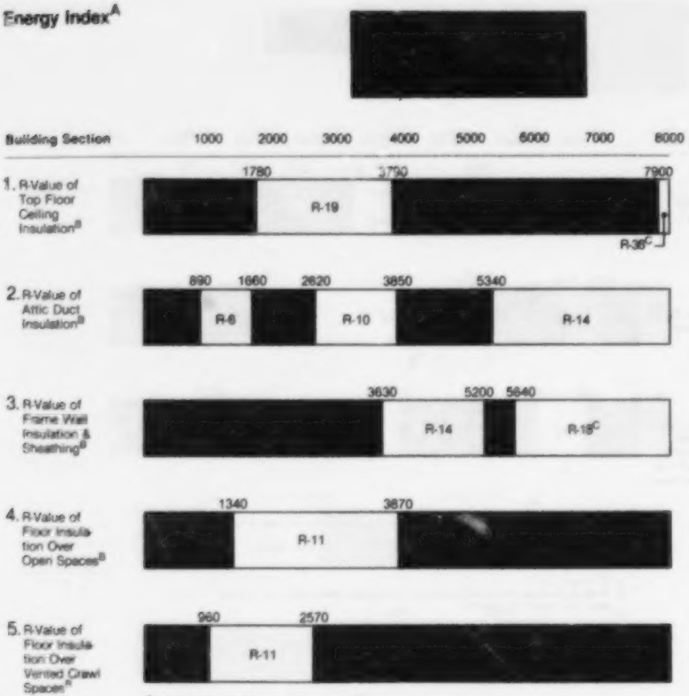
Adjustment factors for each ECT are shown as Note A directly under each page of bar graphs in the guidelines. More precise adjustment factors or the ECTs shown in the guidelines or for any other proposed ECT may be determined by following the procedure shown in the **"Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)"** page 39.

Local Energy Indices (EIs):

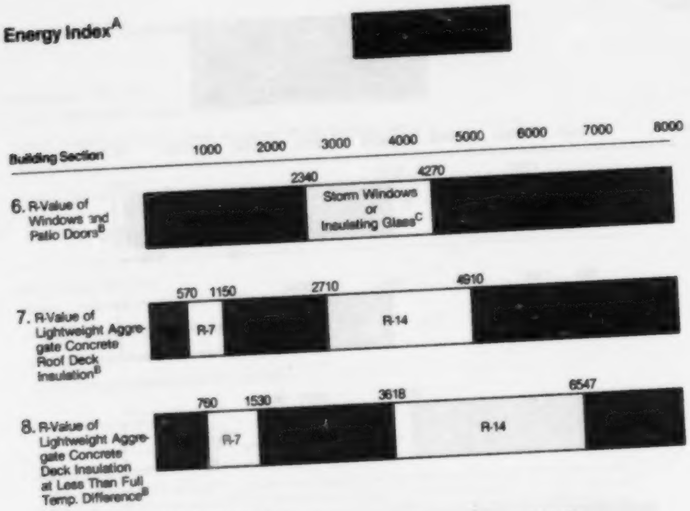
		HI	+	(r)	CI	=	EI
Ceilings	=	________	+	(1.2)	________	=	________
Frame Walls Floors Over Open Spaces	=	________	+	(1.0)	________	=	________
Masonry Walls Rigid Roof Decks	=	________	+	(1.0)	________	=	________
Windows and Patio Doors	=	________	+	(0.6)	________	=	________
Ducts In (Note: r varies, see appropriate bar graph)	=	________	+	(___)	________	=	________
Perimeter Slab Edges Floors Over Crawl Spaces Basement or Crawl Walls	=	HI ONLY				=	________
Other (describe) ________	=	________	+	(___)	________	=	________

(Date) ________________

Energy Index[A]



1. A. EI = HI + 1.2 CI
   B. Based on installation of blanket insulation. Because loose fill insulation performance and installed costs vary widely, apply local information to the procedure shown in the appendix to determine local guidelines. See Table A on page 16.
   C. Calculated on the basis of conventional trusses, 24" O.C., with compression of the insulation at and near the eaves.
2. A. EI = HI + 2.0 CI
   B. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table B on page 16.
3. A. EI = HI + CI
   B. R-values shown are the sum of the thermal resistances of insulation and sheathing. Approximate sheathing R-values are shown in Table C on page 16.
   C. Index shown is the average of three construction techniques (R-13 + 1" extruded polystyrene, R-11 + 1" isocyanurate or polyurethane, compressed R-19 between 2" × 6" framing member + conventional sheathing.
4. A. EI = CI
   B. Applies to cantilevered floors and floors of living areas over garages.
5. A. EI = HI (CI not considered)
   B. Applies to floors over vented crawl spaces with fixed, permanently open wall louvers.

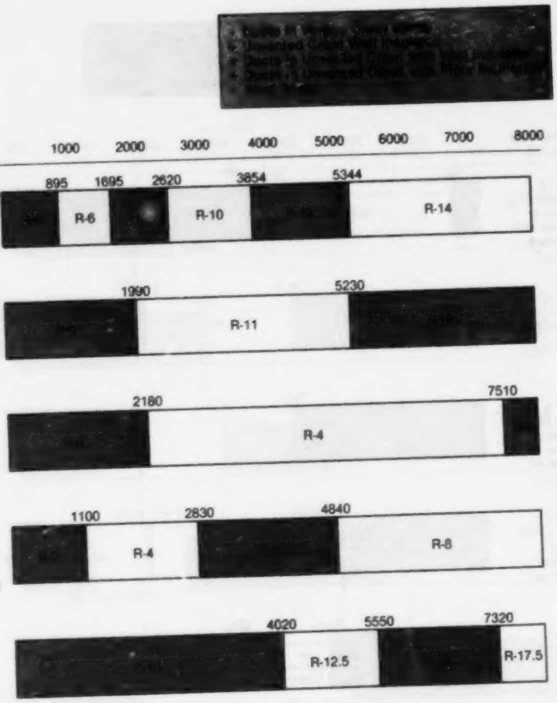


6. A. EI = HI + 0.6 CI
   B. Applies to all sash materials and glazing systems. Assumes thermal break in sash with multiple glazing.
   C. Basement windows require an index of at least 4780 to justify storm panels.
   D. Triple glazed patio doors generally not available.

7. A. EI = HI + CI
   B. R-values shown are the values of insulated roof decking placed above the concrete deck. See Table F on page 19.

8. A. EI = 2HI + 2CI
   B. Applies to concrete decks such as partially heated garages. R-value is for insulation only. Calculated at a temperature difference of 24°F. See Table E on page 19.

Energy Index[A]



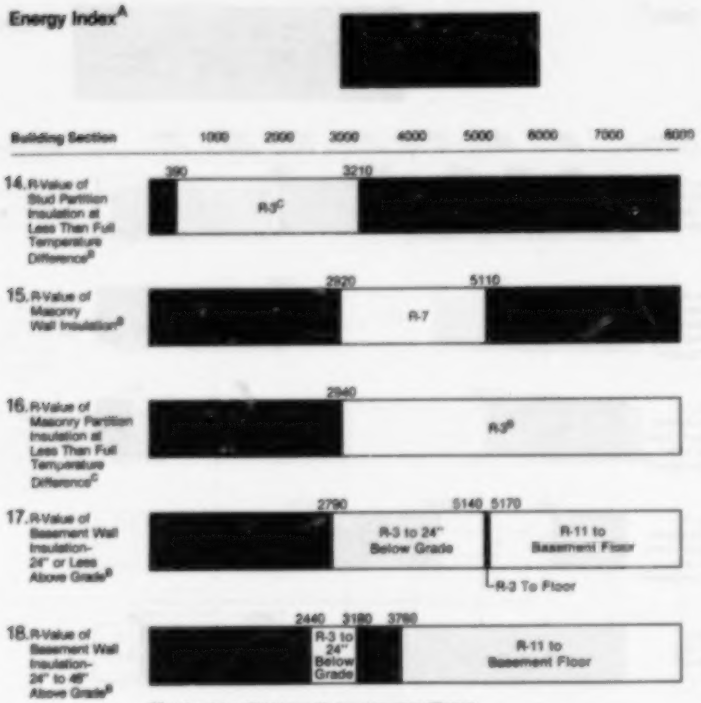
9. A. EI = HI + CI
   B. Applies to vented crawl spaces with floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table B on page 18.

10. A. EI = HI (CI not considered)
    B. Applies to crawl spaces with no ventilation or with closeable louvers. Insulation installed vertically on perimeter wall and horizontally 24" over crawl space floor.

11. A. EI = HI + 5.0 CI
    B. Applies to ducts in unvented crawl spaces with no floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table B on page 18.

12. A. EI = HI + 2.0 CI
    B. Applies to ducts in unvented spaces with floor insulation above. Insulation R-value shown refers to thermal resistance as installed, including compression. See Table B on page 18.

13. A. EI = HI + 0.7 CI
    B. Applies to open beam construction. For flat or sloped ceilings with gypsum board interior finish, use the ceiling insulation bar graph above. Approximate deck insulation thicknesses are shown in Table E on page 19.



14. A. EI = 2HI + 2CI (HI factored for lower temperature difference)
B. Partitions between fully conditioned space and partially conditioned space such as between an apartment and an interior stairwell. Calculated at a temperature difference of 24°F.
C. R-3 based on aluminum foil-backed gypsum board.

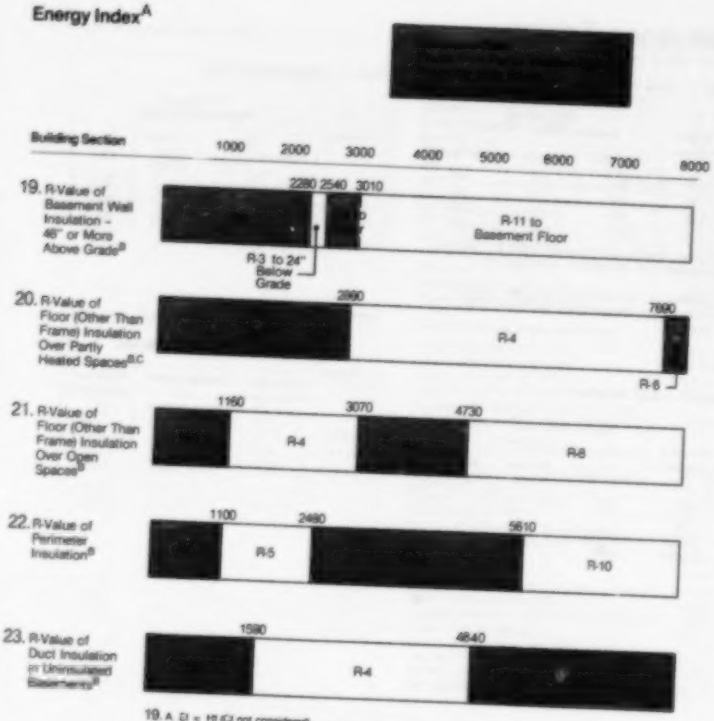
15. A. EI = HI + CI
B. R-5 based on isocyanurate used in a nominal 1" furred space.
R-7 based on foil-back gypsum on 1/2" isocyanurate on 1/2" metal channel.
R-11 based on blanket insulation between 2" × 3" framing members set out 1" clear of masonry. For brick veneer walls use guideline for frame walls.

16. A. EI = 2HI + 2CI
B. R-3 based on aluminum foil-backed gypsum board.
C. Calculated at a temperature difference of 24°F.

17. A. EI = HI (CI not considered)
B. R-3 based on aluminum foil-backed gypsum board on 1" furring.
R-11 based on blanket insulation between 2" × 3" framing members set out 1" clear of masonry.

18. A. EI = HI (CI not considered)
B. R-3 based on aluminum foil-backed gypsum board on 1" furring.
R-11 based on blanket insulation between 2" × 3" framing members set out 1" clear of masonry.

Energy Index^A



19. A. EI = HI (CI not considered)
    B. R-3 based on aluminum foil-backed gypsum board on 1" furring. R-11 based on blanket insulation between 2" × 3" framing members set out 1" clear of masonry.

20. A. EI = 2HI + 2CI (HI factored for lower temperature difference)
    B. Floors between fully conditioned space and partially conditioned space such as between an apartment and unheated basement. Calculated at a temperature difference of 24°F.
    C. R-values shown are the values of insulation to underside of floor. See Table B on page 18.

21. A. EI = HI + CI
    B. R-values shown are the values of insulation to underside of floor. See Table B on page 18.

22. A. EI = HI (CI not considered)
    B. Insulation installed vertically, or vertically and under slab (24" total). See Table D on page 18.

23. A. EI = HI + 2.0 CI
    B. Applies to ducts in basements with neither wall insulation nor floor insulation above. Insulation R-value shown refers to thermal resistance as installed. See Table B on page 18.

Reference Tables

Table A — Blown Ceiling Insulation

Installed R-Value	Approximate In-place Settled Thickness		
	Cellulose	Fiberglass	Rockwool
R-19	5.6"	8.8"	6.5"
R-26	7.6"	12.0"	8.9"
R-30	8.8"	13.0"	10.3"
R-38	11.1"	17.5"	13.0"

*Assumes density and coverage equal to manufacturer's bag label installation specifications.

Caution: Do not specify or purchase blown insulation by inches of thickness. Specify by R-value.

Table B — Duct Insulation

Installed R-Value	Approximate Out-of-Package Thickness		
	Duct Wrap	Flexible Duct	Rectangular Duct Board
R-4	1-1/2"	1-1/8"-1-1/4"	1"
R-6	2"		1-1/2"
R-8 or Greater	Multiple Layer		

Table C — Sheathing Materials

Thickness	R-Value of Sheathing Materials			
	Plywood	Fiber-board	Extruded Poly-styrene	Isocyan-urate
1/2"	R-0.6	R-1.2	R-2.5	R-3.6
3/4"	R-0.94		R-3.8	R-5.4
1"		R-2.1	R-5.0	R-7.2

Table D — Perimeter Insulation

R-Value	Approximate Thickness		
	Extruded Polystyrene	Isocyanurate or Polyurethane	Expanded Polystyrene
R-5.0	1"	3/4"	1-1/2"
R-7.5	1-1/2"	1"-1-1/4"	2"
R-10.0	2"	1-3/8"-1-5/8"	2-1/2"

Table E — Rigid Deck Insulation

R-Value	Approximate Thickness		
	Extruded Polystyrene	Isocyanurate or Polyurethane	Rigid Glass Fiberboard
R-5.0	1"	3/4"	
R-7.5	1-1/2"	1"-1-1/4"	
R-10.0	2"	1-3/8"-1-1/2"	2-1/2"
R-12.5	2-1/2"	1-3/4"-1-7/8"	3"
R-15.0	3"	2-1/8"-2-1/4"	3-1/2"
R-17.5	3-1/2"	2-3/8"-2-5/8"	4"
R-20.0	4"	2-3/4"-3"	4-1/2"

Table F — Roof Deck Insulation

R-Value	Approximate Thickness		
	Perlite/Urethane	Urethane	Perlite
R-5.0		3/4"-7/8"	2"
R-7.5	1-1/2"-1-3/4"	7/8"-1-1/4"	
R-10.0	1-3/4"-2"	1-1/4"-1-1/2"	
R-12.5	2"-2-1/4"	1-1/2"-1-7/8"	
R-15.0	2-1/4"-2-1/2"	1-7/8"-2-1/4"	
R-17.5	2-3/4"-3"	2-1/4"-2-5/8"	
R-20.0	3"-3-1/4"	2-5/8"-3"	

Table G — Selected Values for Structural and Finish Materials, Insulations, Air Spaces, and Surface Films*

Wood bevel siding, 1/2" × 8", lapped	R-0.81
Wood siding shingles, 16", 7½" exposure	R-0.87
Asbestos-cement shingles	R-0.03
Stucco, per inch	R-0.20
Building paper	R-0.06
1/2" nail-base insul. board sheathing	R-1.14
1/2" insul. board sheathing, regular density	R-1.32
25/32" insul. board sheathing, regular density	R-2.06
1/4" plywood (Douglas fir)	R-0.31
3/8" plywood (Douglas fir)	R-0.47
1/2" plywood (Douglas fir)	R-0.62
5/8" plywood (Douglas fir)	R-0.77
1/4" hardboard	R-0.25
Softwood, per inch	R-1.25
Softwood board, 3/4" thick	R-0.94
Vapor barrier — plastic film	R-negl

Concrete blocks, three oval cores

Cinder aggregate, 4" thick	R-1.11
Cinder aggregate, 12" thick	R-1.89
Cinder aggregate, 8" thick	R-1.72
Sand and gravel aggregate, 8" thick	R-1.11
Lightweight aggregate, (expanded clay, shale, slag, pumice, etc.), 8" thick	R-2.00

Concrete blocks, two rectangular cores

Sand and gravel aggregate, 8" thick	R-1.04
Lightweight aggregate, 8" thick	R-2.18
Common brick, per inch	R-0.20
Face brick, per inch	R-0.11
Sand-and-gravel concrete, per inch	R-0.08
Sand-and-gravel concrete, 8" thick	R-0.64
1/2" gypsumboard	R-0.45
5/8" gypsumboard	R-0.56
1/2" lightweight-aggregate gypsum plaster	R-0.32
25/32" hardwood finish flooring	R-0.68
Asphalt, linoleum, vinyl, or rubber floor tile	R-0.05
Carpet and fibrous pad	R-2.08
Carpet and foam rubber pad	R-1.23
Asphalt roof shingles	R-0.44
Wood roof shingles	R-0.94
3/8" built-up roof	R-0.33

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*Additional resistance values can be obtained from *ASHRAE Handbook of Fundamentals* published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1977.

Glass

Single glass (winter)	U = 1.10
Single glass (summer)	U = 1.04
Insulating glass (double)	
1/4" air space (winter)	U = 0.58
1/4" air space (summer)	U = 0.61
1/2" airspace (winter)	U = 0.49
1/2" air space (summer)	U = 0.56
Insulated glass (triple)	
1/2" air space (winter)	U = 0.39
1/4" air space (summer)	U = 0.44
Storm Windows	
1" to 4" air space (winter)	U = 0.50
1" to 4" air space (summer)	U = 0.50

Insulation Batt and Blanket

2" - 2-3/4" thick	R-7.00
3" - 3-1/2" thick	R-11.00
3-1/2" - 6-1/2" thick	R-19.00
Apx. 8.5" thick	R-30.00

Air Spaces (3/4")

Heat flow up	
Nonreflective	R-0.87
Reflective, one surface	R-2.23
Heat flow down	
Nonreflective	R-1.02
Reflective, one surface	R-3.55
Heat flow horizontal	
Nonreflective (also same for 4" thickness)	R-1.01
Reflective, one surface	R-3.48

Note: The addition of a second reflective surface facing the first reflective surface increases thermal resistance values of an air space only 4 to 7 percent.

Surface Air Films

Inside (still air)	
Heat flow up (through horizontal surface)	
Nonreflective	R-0.61
Reflective	R-1.32
Heat flow down (through horizontal surface)	
Nonreflective	R-0.92
Reflective	R-4.55
Heat flow horizontal (through vertical surface)	
Nonreflective	R-0.68
Outside	
Heat flow any direction, surface any position	
15 mph wind (winter)	R-0.17
7.5 mph wind (summer)	R-0.25

Example Calculations

Wall Construction	Uninsulated Wall Resistance	Insulated Wall Resistance
Outside surface (film), 15 mph wind	0.17	0.17
Wood bevel siding, lapped	0.81	0.81
½" ins. bd. sheathing, reg. density	1.32	1.32
3½" air space	1.01	
R-11 insulation		11.00
½" gypsumboard	0.45	0.45
Inside surface (film)	0.68	0.68
Totals	4.44	14.43

For uninsulated wall, $U = \frac{1}{R} = \frac{1}{4.44} = U = 0.22$

Therefore, heat loss for the above uninsulated wall section at a + 10°F outside design temperature is equal to 0.22 × 60 (or 70–10) equals 13.2 Btuh per sq. ft. of wall section.

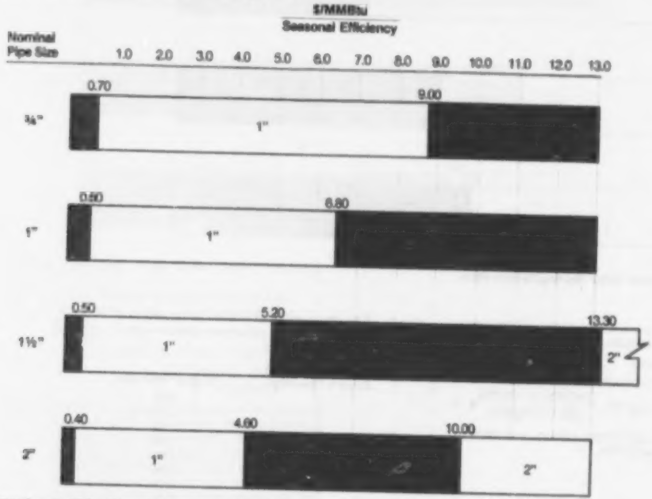
For insulated wall, $U = \frac{1}{R} = \frac{1}{14.43} = U = 0.07$

Therefore, heat loss for the above insulated wall section at a + 10°F outside design temperature is equal to 0.07 × 60 (or 70–10) equals 4.2 Btuh per sq. ft of wall section.

Pipe Insulation

The following is a special section on pipe insulation for domestic hot-water circulating systems, hot-water circulating lines, and chilled-water circulating lines. This section has been included as an additional energy conservation technique that can be used in apartment buildings. The location of the pipe circulating line within the building or building complex requires engineering calculations that very from the procedure used to obtain Energy Index Breakpoints (EIB) used for the preceding bar graphs; therefore, each one of the following charts should be used independently. The procedure for finding the cost-effective level of pipe insulation is included with each chart.

Domestic Hot-Water System Pipe Insulation for Central Continuous Circulating Line



Procedure for Using Domestic Hot-Water Pipe Chart

Step 1. Obtain the price of energy to heat domestic water in units of \$/MMBtu.

Example:		
	Gas	\$/Therm or 100 cu. ft. × 10
	Electricity	\$/Kwh × 29.3 × 10
	Fuel Oil	$\frac{\$/\text{Gallon} \times 100{,}000}{\text{Btu value/gallon}} \times 10$

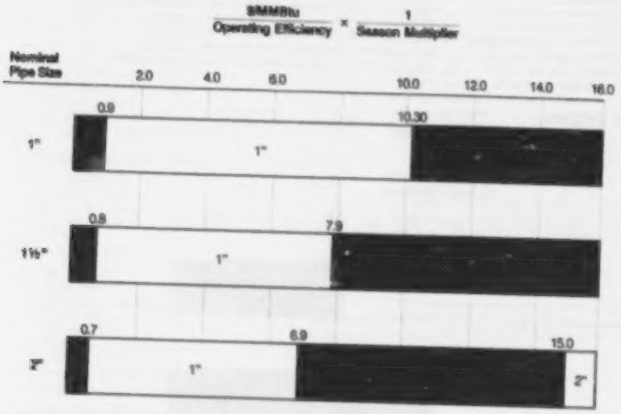
Step 2. Establish the seasonal efficiency of your heating equipment.

Step 3. Divide your local energy cost (Step 1) by the seasonal efficiency (Step 2). Locate this number on the horizontal bar.

Step 4. Drop vertically to the specific bar which represents the nominal pipe diameter under consideration.

Step 5. Record the level of pipe insulation that is economically justified.

Hot-Water Space Heating System Pipe Insulation for Central Contintinuous Circulating Line



Procedure for Using Hot-Water Heating System Pipe Chart:

Step 1. Obtain the price of energy to heat the water in units of $/MMBtu.

Example: Gas $/Therm or 100 cu. ft. x 10
Electricity $/Kwh x 29.3 x 10
Fuel Oil $\frac{\$/\text{Gallon} \times 100{,}000}{\text{Btu value/gallon}} \times 10$

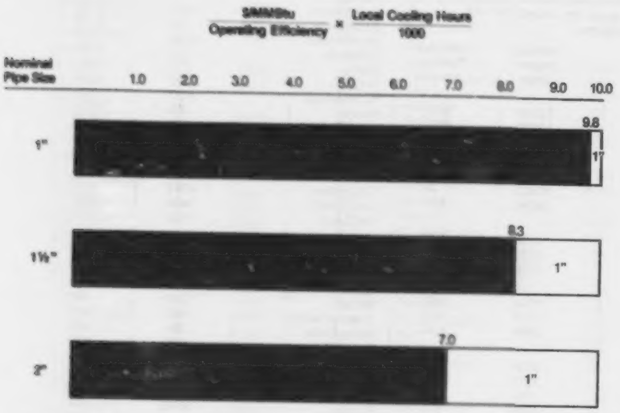
Step 2. Obtain the operating efficiency and divide that into the MMBtu.

Step 3. Using the number of months of heating system operation, select the season multiplier from the chart.

Months of Heating System Operation	Season Multiplier
2	3.00
3	2.00
4	1.50
5	1.20
6	1.00
7	0.86
8	0.75
9	0.67

Step 4. Multiply the answer from Step 2 by the season multiplier. This will give the $ value to use in determining the proper pipe insulation.

Central Cooling System for Main Circulating Line



Procedure for Using Central Chilled-Water Pipe Chart

Step 1. Obtain the price of energy to operate the chilled-water system in units of $/MMBtu.

Example: Gas $/Therm or 100 cu. ft. × 10

Electricity $/Kwh × 29.3 × 10

Fuel Oil $\frac{\$/\text{Gallon} \times 100{,}000}{\text{Btu value/gallon}} \times 10$

Step 2. Obtain the operating efficiency of the system and then divide that number into the MMBtu.

Step 3. Select the appropriate number of cooling hours for your city. Reference table on pages 24–28. Divide the number by 1000 and then multiply the answer with the answer from Step 2. The final number located on the chart will indicate the thickness of pipe insulation to be used.

Degree Days and Cooling Hours for Cities

If your city is not listed here, consult your local weather service or select the nearest city with similar climatic conditions.

Location	Heating Degree Days	Annual Cooling Hours
Alabama		
Birmingham	2710	1430
Huntsville	3190	1290
Mobile	1620	1690
Montgomery	2250	1610
Alaska		
Anchorage	10860	40
Fairbanks	14290	190
Arizona		
Flagstaff	7290	540
Phoenix	1680	2010
Tucson	1700	1790
Arkansas		
Fayetteville	3840	1320
Little Rock	3170	1440
Pine Bluff	2590	1490
California		
Bakersfield	2150	1420
Fresno	2610	1180
Los Angeles	1960	530
Redding	4000	800
Sacramento	2700	850
Santa Ana	1670	660
San Bernardino	1890	1450
San Diego	1500	620
San Francisco	3040	180
San Jose	2410	400
Stockton	2760	960
Colorado		
Boulder	5540	700
Colorado Springs	6410	660
Denver	6150	750
Grand Junction	5660	970
Connecticut		
Hartford	6170	630
New Haven	5890	780
New London	5920	690
Stamford	5460	690
Waterbury	5930	640
Delaware		
Wilmington	4930	860
District of Columbia	4240	1080
Florida		
Fort Myers	430	3180
Gainesville	730	2120
Jacksonville	1230	2040
Lakeland	660	2370
Miami	200	3250
Orlando	720	2340
Tallahassee	1520	1720
Tampa	700	2420
West Palm Beach	270	2940
Georgia		
Atlanta	2990	1320
Augusta	2400	1480
Columbus	2380	1540
Savannah	1820	1600
Valdosta	1520	1760
Hawaii		
Hilo	0	2650
Honolulu	0	3950
Idaho		
Boise	5830	680
Coeur d'Alene	6660	480
Idaho Falls	7890	480
Pocatello	7030	640
Illinois		
Carbondale	4080	1210
Evanston	6640	700
Peoria	6070	820
Rockford	6840	690
Springfield	5530	1010
So. Suburban Chicago	6160	790
Indiana		
Fort Wayne	6220	780
Indianapolis	5630	870
South Bend	6460	720
Terre Haute	5360	930
Iowa		
Cedar Rapids	6600	750
Davenport	6090	820
Des Moines	6610	810
Fort Dodge	7070	740
Mason City	7790	660
Sioux City	6960	800
Kansas		
Salina	4980	1010
Topeka	5210	1030
Wichita	4640	1090
Kentucky		
Lexington	4760	1000
Louisville	4610	1150
Owensboro	4200	1130
Paducah	3650	1250

Location	Heating Degree Days	Annual Cooling Hours
Louisiana		
Baton Rouge	1610	1900
Shreveport	2160	1640
New Orleans	1400	2090
Maine		
Bangor	8220	360
Portland	7570	390
Maryland		
Baltimore	4680	970
Cumberland	5070	730
Frederick	5030	990
Salisbury	4220	970
Massachusetts		
Boston	5630	660
Hyannis	5400	490
Pittsfield	7580	570
Springfield	5840	650
Worcester	6970	540
Michigan		
Detroit	6290	710
Flint	7200	580
Grand Rapids	6890	640
Kalamazoo	6660	680
Lansing	6940	610
Traverse City	7700	530
Minnesota		
Duluth	9890	310
Minneapolis	8250	640
Mississippi		
Greenville	2580	1600
Jackson	2260	1620
Meridian	2340	1610
Vicksburg	2040	1700
Missouri		
Jefferson City	4620	1020
Kansas City	4750	1180
Saint Joseph	5440	1080
Saint Louis	4880	1140
Montana		
Billings	7150	580
Butte	9730	530
Helena	8180	500
Missoula	8000	440
Nebraska		
Grand Island	6440	820
Lincoln	6050	820
North Platte	6680	750
Omaha	6290	860
Nevada		
Las Vegas	2610	1760
Reno	6150	700

Location	Heating Degree Days	Annual Cooling Hours
New Hampshire		
Concord	7380	610
Manchester	7100	610
New Jersey		
Atlantic City	4850	830
New Brunswick	5400	820
Newark	4900	840
Paterson	5360	790
Summit	5010	790
Trenton	4980	770
New Mexico		
Albuquerque	4350	1120
Sante Fe	6120	720
New York		
Albany	6900	600
Binghampton	7340	460
Buffalo	6960	610
Elmira	6410	530
Hicksville	5550	770
New York	4900	850
Plattsburgh	7900	500
Poughkeepsie	5820	720
Riverhead	5620	770
Rochester	6760	590
Schenectady	6780	600
Syracuse	6720	630
Utica	7200	620
White Plains	5800	660
North Carolina		
Asheville	4130	1050
Charlotte	3200	1250
Fayetteville	3060	1280
Florence	2490	1450
Greensboro	3010	1090
Raleigh	3440	1180
North Dakota		
Bismarck	8960	550
Fargo	9250	560
Grand Forks	9930	500
Ohio		
Akron	6140	670
Bowling Green	4280	1060
Cincinnati	4830	970
Cleveland	6200	740
Columbus	5670	890
Dayton	5620	940
Springfield	5280	920
Toledo	6430	690
Youngstown	6370	630
Oklahoma		
Oklahoma City	3700	1240
Tulsa	3730	1310

Location	Heating Degree Days	Annual Cooling Hours
Oregon		
Pendleton	5190	620
Portland	4700	340
Pennsylvania		
Allentown	5620	740
Erie	6540	680
Greensburg	5800	710
Harrisburg	5280	800
Philadelphia	4980	920
Pittsburgh	5950	720
Scranton	6160	630
York	5450	800
Puerto Rico		
San Juan	0	630
Rhode Island		
Providence	5950	600
South Carolina		
Charleston	2070	1530
Columbia	2520	1460
Spartanburg	3070	1230
South Dakota		
Rapid City	7370	680
Sioux Falls	7840	730
Tennessee		
Chattanooga	3380	1220
Knoxville	3510	1210
Memphis	3210	1430
Nashville	3610	1210
Texas		
Amarillo	4140	1130
Austin	1720	1860
Corpus Christi	930	2530
Dallas	2320	1820
El Paso	2680	1620
Fort Worth	2390	1700
Houston	1410	2060
Lubbock	3570	1270
McAllen	600	2810
San Antonio	1560	1980
Texarkana	2530	1520
Wichita Falls	2900	1570
Waco	2040	1780
Utah		
Ogden	5850	760
Salt Lake City	5990	820
Vermont		
Burlington	8030	520
Rutland	7440	580
Virginia		
Fredericksburg	4240	1090
Norfolk	3440	1150
Richmond	3910	1090
Roanoke	4150	980

Location	Heating Degree Days	Annual Cooling Hours
Washington		
Seattle	5190	200
Spokane	6770	490
Yakima	5950	580
West Virginia		
Charleston	4510	1010
Huntington	4340	980
Morgantown	5100	680
Wisconsin		
Eau Claire	7970	510
Green Bay	8100	470
La Crosse	7530	610
Madison	7720	640
Milwaukee	7470	570
Wyoming		
Casper	7510	640
Cheyenne	7370	510

Discussion of Adaptability of National Guidelines

The guidelines are intended for use by builders while working in the design phase with architects and engineers to determine appropriate levels of thermal protection and related equipment and systems. Local energy index breakpoints and energy indices should be determined for each apartment or condominininium project and sometimes, depending on orientation and other variables, for each building.

The information necessary to make these calculations, with the exception of local costs, is contained on pages 36–39 . Check with an engineer or architect for the possible need to use micro-climate data for high rise buildings.

Builders may wish to consider modifying the Present Worth Factor used in these guidelines for the specific conditions of a particular apartment or condominium development. The Present Worth Factor is affected to the largest extent by increasing or decreasing the period of analysis or time-to-recoup investment. While 7 years is a commonly used yardstick by which to judge investment of capital, longer periods may be appropriate on a case-by-case basis, particularly for high rise buildings.

The rate of increase in the price of energy and the alternate investment interest rate also have an effect on the Present Worth Factor. Since the rate of increase in the price of energy will vary substantially from community to community and by types of fuel or energy, the local utility company should be contacted to obtain an assessment of the rate it expects the price of its energy to increase during the period of analysis. The utility company should understand that the rate of price increase for energy includes the inflation rate since the analysis is based on current dollars.

The actual rate of return that can be expected from investing the same amount of money in some other alternative should be used in determining the Present Worth Factor.

Each recommended level of thermal protection encompasses a wide range of EIs; therefore, users should examine where a specific EI falls within the bar graph to evaluate possible adjustments in the selection of ECTs necessary to develop a balanced payback for the entire envelope package of recommendations. Selection of a higher performance level than the level indicated by the local EI, e.g. moving from R-19 to R-30, will result in a greater time-to-recoup investment than 7 years. Similarly, selection of a lower performance level will result in a lesser time-to-recoup investment period than 7 years.

By selecting performance levels as close as practical to those indicated by the local EI, a balanced package of ECTs will result, with reasonably equal payback periods. Where local acceptable practice deviates substantially from the guideline for a specific ECT, an overall balance may be obtained by adjusting one or more of the other ECTs either higher or lower in thermal performance level to compensate for the deviation.

These guidelines were developed at the request of the NAHB Special Committee on Energy by the NAHB Research Foundation, Inc., with the cooperation of the NAHB Technical Services Department, in the public interest to aid builders and consumers. Adherence or nonadherence to these guidelines is, of course, entirely voluntary as a matter of the individual discretion of both members and nonmembers of NAHB. They are presented without intent to involve in any way patents, articles, materials, or processes. NAHB and NAHB Research Foundation, Inc., assumes no liability to any patent owner, nor do they assume any obligation whatever to parties who do or do not adhere to these guidelines.

Additional Energy Conserving Techniques

Infiltration

The importance of reducing air-infiltration cannot be overstressed. The amount of glass area and the quality of windows and doors greatly influence the amount of air-infiltration. Poorly fitted windows and doors, not weatherstripped, can negate much of the benefit derived from extra insulation and other energy conserving techniques.

Consider using windows that at least meet the best quality air-infiltration standards of the Architectural Aluminum Manufacturers Association or the National Woodwork Manufacturers Association. When metal windows are selected, use a thermal break. Insulation, tight gasketing, and a thermal break are important when using metal exterior doors. Solid-core, exterior wood doors require tight gasketing, but paneling is not desirable. Low air-infiltration rates and weatherstripping for exterior doors reduce energy use.

Consider:

- Minimizing the use of exhaust fans as permitted within conditioned space in cold climates and select fans with dampers that close tightly.
- Using a sealer between the top of the foundation and the band joist or sill plate.
- Using a sealer between the bottom exterior wall plate and floor sheathing or slab.
- Caulking cracks around doors, windows, and other openings or penetrations of the walls and at corners.
- Using higher grades of caulking. Such grades are more cost-effective since labor remains constant. Latex, acrylic, butyl rubber, and chlorosulfonated polyethylene caulks are intermediate performance types; high performance materials include polysulfide, polyurethane, and silicone.
- Assuring that masonry is installed with full head and bed joints.
- Minimizing cracks in joints of masonry construction through quality control of mortar and use of cured masonry units to reduce shrinkage cracks.
- Minimizing electric outlets in exterior walls.
- Replacing wall sheathing damaged during construction.
- Using automatic closers on all doors leading to the exterior of the building.
- Using card, key, or radio operated garage doors to automatically close doors after use.
- Installing signs on exterior walls near delivery doors, instructing delivery personnel on opening and closing doors.
- Minimizing the stack effect in high rise buildings by using well-weatherstripped doors or adding weatherstripping to loose fitting entry doors, exterior doors, and those in stairways.
- Designing details for curtain wall constructions that provide both adequate expansion/contraction clearance without opening cracks or buckling panels while maintaining necessary protection against infiltration.

Continuous vertical openings in high rise buildings can cause substantial stack or chimney effects. These openings include duct and pipe shafts, stairwells, and elevator shafts. Care should be taken in the design and construction of these openings, especially at the lowest and highest levels, to ensure as little air as possible can pass in and out of the vertical opening.

Insulation Application

Careful attention to the proper installation of insulation reduces heat loss and heat gain. Proper installation includes making sure that:

- All insulated areas are completely covered.
- Ceiling insulation is extended over the top plate.
- When eave vents are used, clearance at the outside plate is left between the top of the insulation and the underside of the roof sheathing.
- Insulation blankets butt snugly where they meet.
- Separate pieces of blanket are applied and snugly butted at framing offsets.
- Blankets are adequately stapled to eliminate gaps between the insulation and framing members.
- Area between rough framing and door and window heads, jambs, and sills are filled with insulation.
- Insulation is placed behind electric boxes and on the outside of the exterior wall piping.
- Band joists are insulated to the level indicated for frame walls.
- Exposed areas of cantilevered floor constructions are insulated.

Mechanical/Electrical Equipment

Time/Temperature Controls

For apartments having individual heating/cooling systems, the installation of a clock thermostat to reduce temperatures at night can result in significant energy savings. This saving will vary according to the type of heating system and geographic location. Also available are clock thermostats that will turn off air-conditioning and have two or more setback or shutoff periods per day. Temperature setback is usually not recommended in most climates when a heat pump is used.

Numerous control systems for conserving energy use are available, including some that are highly sophisticated, such as automatic load management devices for central heating and cooling systems. Selection is dependent on a number of variables so it should be discussed with the mechanical engineering designer. Consider using an automatic cutoff blower for central heating and cooling equipment when patio or balcony doors are opened.

Domestic Water Heating

The water heater is frequently the second largest energy user in apartments or condominiums. Generally, an individual water heater consumes less energy and is a better choice than a central water heating system, unless the central system is well insulated and has minimum pipe lengths.

Individual Apartment and Condominimum Systems

- Individual water heaters should be located as near as possible to the point of greatest use in each unit.
- Investigate the availability of more energy efficient water heaters.
- Set the temperature as low as practical (120° to 125°F) and ask residents to maintain temperature level.
- Use intermittent ignition devices for all pilot lights.
- Insulate hot-water storage tanks.
- With the rapid change in available domestic equipment and design, consideration should be given to using heat recovery from individual air-conditioning units to preheat domestic water.
- Use flow restrictors on all shower heads.

Central Systems

- Maintain water temperature as low as possible and still provide satisfactory service to the occupants.
- Consider a heat recovery system for preheating water when appropriate.
- Use flow restrictors on all shower heads.
- Consider using self-closing faucets or timing devices for public areas such as laundries and swimming pool locker rooms.
- Minimize circulating systems by using smaller systems with shorter water circuits that do not require a pump when possible. Multiple water heating units installed at various points in large systems to shorten piping runs reduces energy losses.
- Insulate water heating units and storage tanks.
- Insulation on pipe mains is nearly always cost-effective, often cost-effective on individual unit runout lines, and rarely cost-effective on pipes to every faucet. Consider automatic temperature and shutdown controls to limit temperatures and deactivate units when they are not needed.
- Use intermittent ignition in lieu of continuous pilot flame
- Consider solar hot-water-assisted systems in areas where energy prices or solar radiation levels are high or especially when both conditions are present. This may be especially appropriate for garden apartment buildings with relatively large, flat roofs in milder climates.
- Consider combining space heating and domestic water heating during the heating season. During the summer a separate domestic water heater will be required since large heating boilers at slight loads will operate at lower efficiency.
- Consider installing a 24-hour or 7-day clock on the domestic hot-water circulating pump to turn it off during periods with little or no need for hot water.

Individual Dwelling Heating and Cooling Equipment

Mechanical equipment should be properly sized. Oversizing costs more, uses more energy, is less efficient, and produces lower comfort levels. When selecting appliances and mechanical/electrical equipment, consider the comparative energy efficiency of each. The Energy Efficiency Ratio (EER)* is presently the commonly used efficiency rating method for air-conditioning. The higher the EER, the greater the energy savings. Until recently the typical EER for residential equipment was in the six to seven range. Now equipment having an EER in the seven to eight range is common. Some equipment is available with an EER of nine to ten.

When using electric heat in combination with air-conditioning, consider using the heat pump. The Seasonal Performance Factor (SPF) for a heat pump is almost always greater than electric resistance heat and therefore results in lower operating costs in most areas of the country. In areas having either hot or cold temperature extremes, consult the local power company for advice on the merits of heat pump use.

Several newer mechanical/electrical devices to conserve energy are becoming available. These include:

- Automatic stack dampers that close the flue when the furnace is off;
- Intermittent ignition devices for gas furnaces and ranges;
- Heat exchangers to capture waste heat from air-conditioners to heat water;
- Solar water heating or space heating systems in areas where they are justifiable.

Avoid running ducts through nonconditioned spaces in individual ducted systems. If this is not possible then insulate the ducts in accordance with the guidelines. Avoid undersizing duct work. Use of low-friction fittings and minimizing turns increases system efficiency. To reduce duct leakage, keep duct runs short and insure that all joints are properly taped and sealed, including along the crimp. Seal joints in metal ducts even if they are to be covered with insulation. As the thermal efficiency of the envelope improves, simpler duct systems costing less money become possible.

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*A Federal Regulation change is pending to drop EER as the rating procedure for air-conditioning equipment. Until the new procedure is determined and approved, NAHB will continue to reference the EER rating.

Central Heating and Cooling Systems

The subject of central heating and cooling systems is extremely complex, both in engineering design and dependence on local constraints. The following comments are to provide the builder and/or owner with information to be considered in their direction of the engineering planning and design of an apartment or condominium.

Heating Equipment

Boilers

The number and size of boilers should be selected based upon the operating hours at partial load conditions. Generally, several smaller boilers will be more energy-efficient than one large boiler since they will operate for longer hours at full load and therefore at highest efficiency.

- Investigate possible need for chemical treatment of water.
- Seasonal efficiencies of the prime energy conversion equipment should be considered when selecting equipment. Typical seasonal efficiencies* are as follows;

Gas	70 percent
Oil	60
Coal	50

- Reduce blowdown frequency by not including automatic blowdown devices on boilers unless such equipment samples and monitors the pH content and conductivity of the boiler water periodically and operates only when required to maintain acceptable water quality. Some automatic blowdown devices continuously operate at preset frequencies, resulting in a steady energy drain.
- Make piping provisions that permit on-line boilers to maintain temperature in idle boilers in lieu of a fuel-fired standby boiler.
- Install a fan and necessary ductwork to utilize the warm air of a boiler/furnace room near the ceiling section to preheat combustion air.
- Consider installation of a heat exchanger to preheat domestic water where condensate heat is being wasted.
- Reclaim heat by utilizing boiler blowdown, boiler stack heat, and condensate. Typical heat reclamation equipment includes thermal wheels, heat pipe systems, and various types of heat exchangers.
- Preheating combustion air increases boiler efficiency by decreasing the cooling effect of air entering the combustion chamber and promotes better fuel–air mixing.
- Use intermittent ignition in lieu of gas pilots.
- Prevent burner short cycling.
- Preheating oil may increase efficiency. Recommendations of the local oil supplier should be followed.
- Insulate the exterior surfaces of boilers.
- Air–atomizing burners may be more efficient than steam–atomizing burners.
- Consider using automatic viscosity controls on fuel oil burners for purposes of attaining optimum atomization for greater combustion efficiency.

Cooling Equipment

Chillers/Compressors/Condensers

- Select equipment with high seasonal efficiencies.
- Pipe chillers in series unless there will be long hours of cooling operation. The chiller closest to the cooling load will operate at higher suction pressures and use less energy per unit of refrigeration. Where there will be long hours of cooling operation, consider piping chillers in parallel after determining the energy consumption of the pumps in conjunction with the chillers.
- Allow for bypass around the off-line chillers.
- Have analysis made of the number and size of chillers to be selected in order to maximize the number of operating hours at full load for each chiller, thus yielding maximum operating efficiency.
- Isolate off-line chillers.
- Use low–temperature condenser water to increase chiller efficiency. In the use of low–temperature water, review cooling tower fan energy requirements for some cooling towers and/or excessively humid climates that can offset chiller energy savings by excessive cooling tower fan energy.
- Consider the installation of automatic condenser tube cleaners where chillers operate for long hours and where the quality of condenser water is poor. This device will reduce fouling and consequently lower condenser temperatures.
- Use water treatment if water quality so indicates.
- Provide controls to vary chilled water temperature as the cooling load modulates.
- Avoid the use of chillers with a hot gas bypass whenever possible.

Cooling Towers

- Locate cooling tower in shade or partial shade, if possible.
- Monitor water quality of tower in order that chemical water treatment can be added when required.
- Consider automatic controls to turn off power fans when loads are light and the total pressure and volume (enthalpy) of the air is low.
- Obtain professional assistance when contemplating air–cooled condensers in lieu of cooling towers. The system efficiencies can be signifi-

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*These efficiencies are higher than those used for individual apartment units since larger units are maintained on a more regular basis.

cantly increased in locations with a low number of wet-bulb degree hours.
- Consider the difference in the performance of induced-draft versus forced-draft cooling towers. These differences include not only substantial differences in fan horsepower, but also differences in natural draft performance.

Air-Handling Systems and Garage Ventilation

- Air-handling systems that serve spaces not occupied 24 hours per day should be separately controlled so they can be turned off when not in use. These spaces include some public areas, commercial space, and office space.
- Where indoor garages require ventilation, provide means for controlling the hours of operation and the quantity of ventilation depending upon the garage usage.

Electrical Distribution and Lighting Systems

Electrical Distribution Systems

Electrical Service

If higher voltages are available, a study should be made to assure that an energy-effective and cost-effective voltage is selected, i.e., if higher voltages are available, greater efficiencies may be achieved.

Voltage Drop

Electrical design should be made to maintain voltage drop at not more than 3 percent in branch circuits or feeders, or a maximum of 5 percent at the farthest outlet.

Motor Efficiency

Motor efficiency ratings should be requested in order to make cost and energy use analysis. High efficiency motors are available in most sizes and generally their extra cost is quickly paid back.

Motor Sizing

Carefully analyze motor requirements to protect against unnecessary oversizing.

Transformer

Consideration should be given to location in order to keep the transformer as close as possible to the load it will serve. When permitted, minimize the number of transformers and hold the size to match requirements. Consider the use of separate transformers for heating and cooling equipment to permit them to be de-energized in summer for heating and in winter for cooling.

Time Clocks

Consider using time clocks and/or time switches for equipment that does not have to operate continuously.

Demand Control

Demand control systems should be considered where electric rate structures make them attractive and where electric loads can be controlled, such as domestic water heating.

Lighting Systems

General

Electric lighting is a major user of electrical energy. With operating and maintenance cost as important factors in apartments and condominiums, careful attention to lighting design can be a significant energy saver. Considerations include:

- Safety and security needs and regulations.
- Fixture cost versus operating efficiency.
- Lamp operating cost relative to energy use per lumen output and lamp life.
- Maintenance and replacement cost.
- Effect on air-conditioning load and operating cost.
- Decorative effect.
- Marketing image.
- Occupant satisfaction.

Lighting Design

Once the required fixtures are sized and located to meet national and local regulations for safety and security, the remaining fixtures should receive close review. Consideration should be given to:

- The use of natural lighting.
- Direct-use switch control of fixtures not requiring continual use.
- Automatic controls for lights not required for safety and security.
- Time clock or photo-electrically controlled outdoor fixtures.
- Avoiding use of recessed lighting fixtures in the exterior envelope.

Fixture Selection

The careful selection of fixtures is extremely important in the areas of energy use and maintenance cost. Therefore, before using any incandescent light fixtures, careful review should be made of more efficient light sources (fluorescent indoors and low and high pressure sodium, metal halide, and mercury vapor lamps outdoors). The review should include fixture cost, operating cost, lamp-life cost, fixture-time phased-output level, and lamp relacement cost. Particular care and attention should be paid to lighting that operates 24 hours per day such as lobbies, corridors, and stairwells. This lighting constitutes a substantial portion of the electricity consumed. Garage lighting for indoor parking areas that operate 24 hours per day also should be selected carefully.

When incandescent lighting is used for decorative reasons, care should be given to lamp wattage. Oversizing will use more energy than required and possibly exceed fixture design. This will shorten lamp life and may create a potential fire hazard. "Long life" bulbs cost more and give less light. They should be used only in difficult to reach places.

Construction Techniques

Foundations

Extra supervision to assure that all concrete and masonry, especially the top of foundation or slab is square, plumb, and level, will reduce air-infiltration and save labor in framing and trim time. Construction practices to minimize air-infiltration will require the same kind of supervision and detailed attention to eliminating cracks and space around wires, pipes, and ducts as is necessary to attain good acoustical performance.

Framing

Eliminating unnecessary framing members in ceilings, exterior walls, and floors when exposed to non-conditioned spaces will help reduce heat loss and heat gain. Examples of methods that will reduce heat flow through framing members are 24-inch on-center framing, 2-stud corners, 1x4 bottom wall plate, drywall backup clips at partition intersections, and the use of plywood box headers filled with insulation. For details of other lumber saving techniques, see the NAHB Research Foundation's *Manual of Lumber and Plywood Saving Techniques* (see page 41).

Masonry and Concrete Construction

To the extent feasible, and especially in colder climates, avoid outside exposure of structural elements such as concrete slabs or beams, thus creating an energy short circuit. This may affect the use of balconies and eyebrow-type construction.

Moisture Control

The equivalent of a kraft-faced vapor barrier should be installed on the inside surface of exterior walls. Care should be taken to assure proper installation of vapor barriers.

The use of polyethylene or equivalent vapor barriers is discouraged in ceilings of apartments whose attics have adequate ventilation and in units that are electrically heated or heated with fossil-fuel furnaces provided with outside combustion air.

In situations where adequate ventilation is difficult to achieve, such as cathedral ceilings, hip roofs, etc., installation of a polyethylene or equivalent vapor barrier should be considered for use on the underside of the ceiling section. Other methods of vapor control, such as humidistatically controlled power ventilation of the ceiling space above the insulation or the living area, may need consideration in some climates.

Install a 4- or 6-mil polyethylene vapor barrier on the ground in crawl spaces and beneath both on-grade and basement slabs.

A vapor barrier is not required when insulation is installed in floors above unheated basements or unvented crawl spaces having a polyethylene vapor barrier ground cover.

Design

Building Shape

Energy use can be reduced by lowering the ratio of exterior wall area to floor area. H, T, X, Y, and L shaped buildings have higher ratios of exterior wall to floor area than rectangular buildings with the same floor area. Rectangular buildings utilize less energy than structures having higher ratios of exterior wall to floor area. Reducing the ceiling height to the code minimum saves energy since wall heat loss is related to the area of the exterior wall.

Orientation and Shading

Give serious consideration to minimizing glass areas on east and west walls when orienting buildings. Shading glass facing south with the proper overhang reduces heat gain in summer and allows solar gain in winter. Balconies, particularly in high rise apartments, can be used effectively for this purpose although, as noted above, they may provide an energy short circuit. In hot climates, tinted or reflective east/west and shaded south glass can significantly reduce heat gain. Where feasible in cold climates, protect the structure from prevailing winter winds by the suitable location of attached garages, carports, storage facilities, etc. When feasible, in hot climates, put these structures on the east or west side.

Public Areas

Area and volume of public areas should be minimized.

Locate wall hangings, furniture, etc. away from supply and return air grills and registers to prevent obstruction of air flow. Consider use of light color wall surfaces to reflect light so glass areas may be kept to a minimum.

Consider a vestibule for the front entrance where practical. Self-closing weatherstripped doors will save energy. Provide sufficient distance between doors to allow closure of one door before the other is opened. Revolving doors are very costly and have high air-infiltration rates. Consider using automatic entry doors, particularly in luxury high rises.

Habitable Space Ventilation

Reduce the number of air changes per hour to the minimum level required by building codes for health and safety. Consider the use of time clocks to reduce or shutoff ventilation during hours when it is not necessary. In general, requirements for ventilating air greater than 5 c.f.m./person can be considered excessive.

Fireplace

Fireplaces improperly designed and constructed result in significant heat loss, a fact that should be borne in mind when market conditions dictate their use. Tight fitting dampers and glass doors reduce heat loss when the fireplace is not in use. Supplying outside air to the firebox will reduce heat loss from the home and improve performance where practical.

Also, consider devices for heat recovery and recirculation of air for conventional fireplaces. The new generation of prefabricated fireplaces includes dampers, glass doors, outside air ducts to the firebox, and hot air circulation systems. Avoid the use of masonry fireplaces on outside walls. When prefabricated fireplaces are utilized on outside walls, care should be taken to insulate adjacent walls.

Attic Ventilation

Adequate natural ventilation of the attic space helps to reduce summer air temperatures and allows moisture vapor to escape. One square foot of *net* free vent area should be provided for every 300 square feet of ceiling area with a vapor barrier and double that amount when no vapor barrier is used.

Equipment Maintenance

The importance of a good maintenance program cannot be overemphasized. Not only will effective maintenance help ensure efficient operation of equipment and systems, but it also will help prolong the useable life of equipment. The following are samples of maintenance checklist items:

1. Operate the boiler(s)—decrease gas or oil input rate—so that the boiler(s) will operate over longer periods of time, decreasing off–cycle losses.
2. Clean mineral or corrosion buildup on gas burners.
3. Check burner firing period; if it is improper, it could be a sign of faulty controls.
4. Check oil heaters to ensure that oil temperatures are being maintained according to manufacturer's or oil supplier's recommendations.
5. Check accuracy of recording pressure gauges and thermometers.
6. As appropriate, check reflectors on infrared heaters for proper beam direction and cleanliness.
7. Inspect oil line strainers. Replace if dirty.
8. Check automatic temperature–control system, related control valves, and accessory equipment to ensure that they are regulating the system properly in the various zones—in terms of building heating needs, not system capacity.
9. Inspect zone shutoff valves. All should be operable so steam going into unoccupied spaces can be shut off.
10. Observe the flame when the unit shuts down. If the flame does not cut off immediately, it could indicate a faulty solenoid valve. Repair or replace as necessary.
11. Inspect exhaust from stack. It should be free of haze. If not, it probably indicates that a burner adjustment is necessary.
12. To maintain an efficient system, fans should be cleaned annually.
13. Inspect for obstructions in front of the heating equipment and remove whenever possible. Air movement in and out of convector must be unrestricted.
14. Heat transfer surfaces of radiators, convectors, baseboard, and finned-tubes must be kept clean for efficient operation.
15. Clean heat transfer surfaces of all electric heating units and remove any obstructions.
16. Inspect air movement in and out of the electric units for obstructions.
17. Calibration of all instruments should be checked annually. As operators notice deficiencies, they should be corrected immediately.
18. Compare original equipment–performance assumption against actual operation.
19. Seal ducts and access doors to equipment rooms to minimize short circuiting of hot and cold air.
20. Maintain power distribution equipment to assure minimum power loss from loose connections and contacts.
21. Keep ventilators clear of debris; clean or replace filters often to increase air–handling unit efficiency.
22. Maintain and clean all fans on a regular schedule.

Building Maintenance and Inspection of Apartments

A regular building inspection is an essential part of a successful energy conservation program. The person conducting the inspection should know what to look for and be provided with a checklist. That person should have a copy of the architectural, mechanical, and electrical design drawings and specifications of the building and access to any written maintenance and operating procedure manuals supplied by equipment manufacturers.

Water Supply

Inspect water supply system, including faucets and repair leaks. Test hot–water controls to see if they are working properly. Install a pressure reducing valve when main pressures are excessive.

Windows and Skylights

Inspect and replace broken or cracked window panes. Replace worn or broken weatherstripping and caulking. Inspect the operation of indoor shading devices (drapes, blinds, etc.).

Doors

Inspect and replace worn or broken weatherstripping and caulking. Adjust misaligned doors. Inspect automatic door closers and adjust for faster closing if necessary. Inspect and repair or replace gasketing on garage doors.

Exterior Surfaces

Inspect caulking, gasketing, or weatherstripping of all exterior joints: between wall and foundation; wall and roof; between wall panels: openings for entrance of electrical conduit, piping, and cooking units; around exhaust fans, air louvers, etc., and replace as necessary.

Lighting

Establish a light usage program for public areas. Inspect to insure that established schedules for the control of lighting are followed.

With master metering, consider providing free lower-watt bulbs to the residents since the cost of energy saved will usually exceed the bulb cost.

Heating, Cooling, Ventilation

Inspect all outside air dampers to ensure they are air tight when closed. Check damper position indicators. Inspect filters carefully and replace regularly. Inspect for obstructed registers in common areas. Request that residents not obstruct registers. Reduce use of heating and cooling systems in unoccupied apartments to the minimum level necessary. Consider closing supply registers and radiators and reducing thermostat settings in lobbies, corridors, vestibules, laundry areas, equipment rooms, etc., when appropriate. Pilot lights in vacant apartments should be turned off, and during the cooling season, pilot lights should be turned off in all apartments.

Appendix

Technical Terms

The technical terms necessary to determine local heating and cooling indices are as follows.

Heating Degree Days

The number of Heating Degree Days in a day is the average of the high and low temperature of that day subtracted from 65°F. For example, if the high for the day is 60°F and the low is 30°F, there are 20 Degree Days in that day, i.e.,

$$65 - \frac{(60 + 30)}{2} = 20$$

Degree days for the year are the sum of the daily degree days and are used as a measure of energy consumption for space heating. Degree days for 270 cities are shown in this manual.

Heating Cost per 100,000 BTU

— Natural gas; \$/100,000 Btu = \$/Therm.

— Fuel oil; $\$/100{,}000\ \text{Btu} = \frac{\$/\text{Gallon} \times 100{,}000}{\text{Btu value/gallon}}$

— Electricity; \$/100,000 Btu = \$/Kwh × 29.3

Accurate determination of local energy costs is extremely important in determining local heating and cooling indices.

Seasonal Heating Efficiency

The seasonal efficiency of a heating system will vary depending on fuel type, equipment type, distribution system, and geographical location. The ASHRAE 1976 Systems Handbook cites effective seasonal efficiencies from 0.50 to 0.78 for natural gas and 0.44 to 0.69 for fuel oil, with 40 percent furnace oversizing. For direct electric heating systems, corresponding efficiencies from 0.77 to 1.20 are shown, with 10 percent equipment oversizing. The higher values apply to cold climates while the lower values apply to mild climates. The efficiencies for central heating equipment are higher than the individual apartment units since larger units are maintained on a more regular basis. In the absence of specific local information, it is suggested that the following seasonal efficiencies be used:

	Individual	**Central**
Natural Gas	0.60	0.70
Fuel Oil	0.50	0.60
Direct Electric	1.00	1.00

Summer Cooling Hours

The summer cooling hours represent the number of equivalent full load operating hours per year that the air-conditioning equipment operates. The number of hours in the entire cooling season is greater than the summer cooling hours shown because of intermittent operation of the air-conditioning equipment under partial load. Cooling hours for over 270 cities are shown in this manual.

Energy Efficiency Ratio (EER)

The energy efficient ratio of air-conditioning equipment is the Btuh output divided by the watt input (Btuh/watt). The higher the EER, the more efficient the equipment and, under identical conditions, the lower the electrical consumption for air-conditioning.

Definition of Heating and Cooling Indices

Heating Index (HI)

The heating index is defined as:

$$HI = \frac{(\text{Degree Days})\ (\$/100{,}000\ \text{Btu})}{\text{Seasonal Heating Efficiency}}$$

Cooling Index (CI)

The cooling index for an individual apartment cooling system is defined as:

$$CI = \frac{(\text{Summer Cooling Hours})\ (\$/\text{Kwh})\ (100)}{\text{EER}}$$

The cooling index for a central cooling system is defined as:

$$CI = \frac{(\text{Factor})(\text{Summer Cooling Hours})(\$/\text{Kwh})(100)}{\text{Equivalent Energy Efficiency Ratio}}$$

The Factor is an adjustment that takes into account the larger number of hours that central systems typically operate compared to individual apartment systems. Depending on the climate and the management's determination of the length of time that cooling will be supplied, the Factor probably ranges from about 1.0 to 1.5.

The Equivalent Energy Efficiency Ratio is the Btuh output divided by the summation of the watts of input for all of the energy using elements of the equipment. This ratio and the Factor can be determined by a professional mechanical engineer.

Calculation of Energy Index Breakpoints (EIB)

The elements necessary to determine Energy Index Breakpoints are as follows:

Owner Cost of Improvement

Estimate additional first cost to the owner of a higher performance level of an ECT such as additional insulation, storm windows, etc. If additional construction costs are necessitated because of the improvement, such costs must be converted to owner costs and included. All costs should be related to the appropriate area or length involved.

Energy Index Breakpoint

A convenient area for calculation purposes is 1000 square feet for opaque building sections, 100 square feet for windows, actual area for patio and opaque doors, and 100 linear feet for duct systems and perimeter slab edges.

Present Worth Factor (PWF) with Rising Energy Cost

First year energy savings (S) are multiplied by the appropriate PWF to estimate the present worth of the sum of the energy savings over a time period (n), with energy price increasing at an annual percentage rate (f). At an alternate investment interest rate (i) of 9 percent, some Present Worth Factors are as follows:

f = rate of increase in energy cost	Time Period (n)					
	3	5	7	10	15	20
15	3.34	5.89	8.72	13.59	23.65	38.81
12	3.17	5.43	7.81	11.65	18.77	26.92
11	3.11	5.28	7.53	11.07	17.40	24.34
10	3.06	5.14	7.26	10.52	16.15	22.04
9	3.00	5.00	7.00	10.00	15.00	20.00
8	2.95	4.86	6.75	9.51	13.94	18.18
7	2.89	4.73	6.50	9.04	12.98	16.56
6	2.83	4.60	6.27	8.60	12.08	15.11

*Refer to page 38 for other interest rates.

Change in Heat Loss/°F

This is usually a change in the overall coefficient of heat transmission (U-value) of a building section. For storm windows and doors the thermal improvement (change in U-value) may be increased by adding the effect of reduced infiltration to the change in U-value. The change in thermal improvement should be reduced for an area at an intermediate temperature, such as a basement or an unvented crawl space. The guidelines include these adjustments.

Change in Heat Gain

Use the appropriate equivalent temperature difference at outside summer design temperature conditions. The guidelines are based on a 95°F temperature combined with a medium daily range, which is applicable to a large portion of the country having a high percentage of apartments equipped with central air-conditioning systems.

The EIB necessary to justify a given level of thermal improvement is found as follows:

For apartments with heating and no air-conditioning:

$$EIB = HIB = \frac{(\text{Owner Cost of ECT})(100{,}000)}{(\text{PFW})(\text{Change in Heat Loss/°F})(\text{Area or Length})(24)}$$

For homes with air-conditioning and no heating:

$$EIB = CIB = \frac{(\text{Owner cost of ECT})(100{,}000)}{(\text{PFW})(\text{Change in Heat Gain/Sq. Ft.})(\text{Area})}(r)$$

For apartments with heating and air-conditioning:

EIB = HIB + (r)(CIB), where:

r = An adjustment factor, applied to the cooling index only, accounts for radiation and other effects on various building sections. Suggested adjustment factors for each ECT shown are noted directly under each page of appropriate bar graphs in the guidelines. A precise adjustment factor for any improvement may be found by calculating the local HIB and CIB required to justify the improvement, and dividing the heating figure by the cooling figure as shown in the following example.

An Example of How to Determine Local EI Breakpoints

Calculate the EIB for R-38 versus R-30 ceiling insulation in a truss framed structure at a buyer cost difference of $80.00 per thousand square feet.

Using methods shown in the 1977 *ASHRAE Handbook of Fundamentals*, a reduction of 0.007 in U-value has been calculated. A 7-year period (n), with a 12 percent increase in annual energy cost (f) and a 9 percent interest (i) is used in this example. The breakpoint for justifying the thermal improvement on the basis of heating savings only is calculated as follows:

$$\text{EIB} = \text{HIB} = \frac{(\text{Buyer cost of ECT})(100{,}000)}{(\text{PWF})(\text{Change in Heat Loss/}^{\circ}\text{F})(\text{Area of Length})(24)}$$

$$\text{EIB} = \text{HIB} = \frac{(80.00)(100{,}000)}{(7.81)(0.007)(1000)(24)} = 6097$$

Similarly, the 1977 *ASHRAE Handbook of Fundamentals* method was used to obtain the reduction of heat gain. The method requires the addition of roof color and climate zone to obtain the information. In the example, the structure is in Climate Zone C and the roof is a light color. The calculated heat gain reduction is .205. This number can be calculated from the table for Climate Zone C in the 2nd Edition of the *Insulation Manual* by dividing the difference in heat gain for the two ECTs by 1.3 to account for the fact that the latent load is unchanged. The breakpoint for justifying the thermal improvement on the basis of cooling savings only is calculated as follows:

$$\text{EIB} = \text{CIB} = \frac{(\text{Buyer cost of ECT})(100{,}000)}{(\text{PWF})(\text{Change in Heat Gain/Sq. Ft.})(\text{Area})}$$

$$\text{EIB} = \text{CIB} = \frac{(80.00)(100{,}000)}{(7.81)(0.205)(1000)} = 4997$$

Either breakpoint equally justifies the investment. When both heating and cooling are considered the indices should be combined utilizing an adjustment factor (r). Average "r" factors for each ECT are shown underneath each corresponding bar graph. In this example, since HIB and CIB are known, the actual "r" factor can be determined as follows:

$$\text{EIB} = \text{HIB} + (r)(\text{CIB})$$

$$r = \frac{\text{HIB}}{\text{CIB}} = \frac{6097}{4997} = 1.22$$

Correspondingly, whenever the local HI + (1.22)CI equals or exceeds 6097, the initial investment under the economic assumptions is in order. Thus:

If HI = 4600 and CI = 1500,
EI = 4600 + (1.22)(1500)
= 6330 (investment justified)

If HI = 2500 and CI = 2000,
EI = 2500 + (1.22)(2000)
= 4940 (investment not justified)

Analyses of a similar nature may be made locally for any level of thermal improvement for opaque building sections, windows, doors, and duct systems. It may be noted that if a 12 percent annual increase in energy cost and a 10 year time period were utilized at the same interest rate, the PWF would be 11.65 and the value of 6097 would be reduced.

Whenever HI + (1.22)CI equals or exceeds $\frac{(7.81)}{(11.65)}(6097)$

= 4087, the investment is justified under those economic assumptions. Some available references on engineering economics are shown in the Bibliography.

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[*] To make the PWF method practical, some simplifying assumptions have been made that do not materially effect the results. Salvage value is not included because most depreciating residential items, like mechanical/electrical equipment or devices, have essentially zero value. For most other ECT's, the salvage value is greater at the end of the period of analysis than its first cost due to the home's appreciation in value (within reasonable time limits). Thus, use of salvage value for such ECT's would justify an unlimited added first cost expenditure. Operating and maintenance costs are ignored because they are zero for most ECT's, except for mechanical/electrical equipment and devices. The added cost of insurance is ignored because it is relatively minor. The effect of added real estate taxes, due to the increased first cost of the added ECT and the effect of the income tax in reducing the added cost of mortgage interest for that added first cost, are omitted because they are minor and tend to offset each other.

Present Worth Factors and Time to Recoup Investment

A PWF equivalent to a 7-year period for time to recoup investment has been used for determining Energy Index Breakpoints (EIB).

The general formula for PWF may be modified to provide for different rates of cost increases for energy and for mortgage or alternative investment interest rates as follows:

$$P = S\left[\frac{a(a - 1)}{a - 1}\right]; \text{ where:}$$

P = Present worth or added cost of ECT.

S = Operating cost savings in the first year, attributable to the added ECT.

n = The period of years of analysis or time to recoup investment.

$a = \frac{1 + f}{1 + i}$; where:

f = The estimated annual percentage rate of price increase for the fuel (or energy) used, expressed as a decimal.

i = The alternate investment interest rate expressed as a decimal.

Thus, the time to recoup investment (n) for an ECT can be determined by the following equation:

$$n = \frac{\log\left[\frac{P(a - 1)}{S} + a\right]}{\log a} - 1$$

EIBs for any selected payback period may be calculated by determining the PWF, when S = \$1.00, as follows:

$$PWF = 1\left[\frac{a(a^n - 1)}{a - 1}\right]; \text{ where:}$$

PWF = Present Worth Factor or added cost of ECT per \$1.00 of operating cost savings in the first year, attributable to the change in thermal performance level of the ECT.

Note: The other symbols were previously listed.

For example:

Assume $f = 12\%$, $i = 9\%$, $n = 6$ years

$$a = \frac{1 + f}{1 + i} = \frac{1.12}{1.09} = 1.02752$$

$$PWF = 1\left[\frac{a(a^n - 1)}{a - 1}\right]$$

$$= 1\left[\frac{1.02752(1.02752^6 - 1)}{1.02752 - 1}\right]$$

$$= 1\left[\frac{0.1818}{0.02752}\right] = 6.61$$

Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)

Describe ECT:

____

____

____

Heating Index Breakpoint (HIB)

Line 1. Establish additional owner cost for a given area (or length for slab edge perimeter or duct insulation of ECT). . . . . = $ __________

Line 2. Multiply Line 1 x 100,000 . . . . = __________

Line 3. Select appropriate Present Worth Factor (PWF table, page 36) . . . . = __________

Line 4. Enter change in heat loss/°F (see discussion, page 36) per unit area or length . . . . = __________

Line 5. Enter area or length used in Line 1 . . . . = __________

Line 6. Multiply Line 3 x Line 4 x Line 5 x 24 . . . . = __________

Hi Breakpoint = $\frac{\text{Line 2}}{\text{Line 6}}$ = ______________________________ = ☐

Cooling Index Breakpoint (CIB)

Line 7. Enter Line 2 from above . . . . = __________

Line 8. Enter PWF from Line 3 above . . . . = __________

Line 9. Enter change in heat gain (see discussion, page 36) per unit length or area . . . . = __________

Line 10. Enter area or length from line 5 above . . . . = __________

Line 11. Multiply Line 8 x Line 9 x Line 10 . . . . = __________

Cl Breakpoint = $\frac{\text{Line 7}}{\text{Line 11}}$ = ______________________________ = ☐

Adjustment Factor (r):

Adjustment Factor (r) = $\frac{\text{HIB}}{\text{CIB}}$ = ______________________________ = __________

Line 12. Energy Index Breakpoint (EIB) = HIB or (r) (CIB) . . . . = __________

Line 13. Local EI = $\frac{\quad}{\text{Local Hi}} + \frac{(\qquad\qquad)\ (\qquad\qquad)}{(r)\,(\text{Local Ci})}$ = __________

If Line 13 is greater than Line 12, the ECT is justified ☐ Yes ☐ No

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Date ____________________

Worksheet to Determine a Local Energy Index Breakpoint (EIB) for an Energy Conserving Technique (ECT)

Describe ECT:
Increasing Ceiling Insulation
from R-30 to R-38 in
truss framed structure

Heating Index Breakpoint (HIB)

Line 1. Establish additional owner cost for a given area (or length for slab edge perimeter or duct insulation of ECT) = $ 80.00 /MSF
Line 2. Multiply Line 1 x 100,000 = 8,000,000
Line 3. Select appropriate Present Worth Factor (PWF table, page 36) = 7.81
Line 4. Enter change in heat loss/°F (see discussion, page 36) per unit area or length = 0.007
Line 5. Enter area or length used in Line 1 = 1000 S.F.
Line 6. Multiply Line 3 x Line 4 x Line 5 x 24 = 1312.08

HI Breakpoint = $\frac{\text{Line 2}}{\text{Line 6}} = \frac{8{,}000{,}000}{1312.08} = \boxed{6097}$

Cooling Index Breakpoint (CIB)

Line 7. Enter Line 2 from above = 8,000,000
Line 8. Enter PWF from Line 3 above = 7.81
Line 9. Enter change in heat gain (see discussion, page 36) per unit length or area = 0.205
Line 10. Enter area or length from line 5 above = 1000 S.F.
Line 11. Multiply Line 8 x Line 9 x Line 10 = 1601.05

CI Breakpoint = $\frac{\text{Line 7}}{\text{Line 11}} = \boxed{4997}$

Adjustment Factor (r):

Adjustment Factor (r) = $\frac{\text{HIB}}{\text{CIB}} = \frac{6097}{4997}$ = 1.22

Line 12. Energy Index Breakpoint (EIB) = HIB or (r) (CIB) = 6097

Line 13. Local EI = $\frac{4500}{\text{Local HI}} + \frac{(1.22)(1500)}{(r)\,(\text{Local CI})}$ = 6330

If Line 13 is greater than Line 12, the ECT is justified ☑ Yes ☐ No

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Date 10/25/78

Suggested Reading List

ASHRAE Handbook of Fundamentals — 1977
ASHRAE Handbook — 1976 Systems
Available from American Society of Heating,
Refrigerating and Air-Conditioning Engineers, Inc.
345 East 47 Street
New York, N.Y. 10017

Energy Conservation in Buildings: Techniques for Economical Design
Griffin, C. W., 1974.
Available from Construction Specifications Institute
1150 17th Street, N.W.
Washington, D.C. 20036

Energy Conservation in New Building Design
ASHRAE Standard 90-75, 1975.
Available from the American Society of Heating,
Refrigerating and Air-Conditioning Engineers, Inc.
345 East 47 Street
New York, N.Y. 10017

Energy Conservation Potential of Modular Gas-Fired Boiler Systems
Kelly, G. E. and Didion, D. A.
NBS Building Science Series 79, 12-75
Superintendent of Documents
SD Catalog No. C13.29:2/79
U.S. Government Printing Office
Washington, D.C. 20402

Energy, Environment & Building.
Stedman, P., 1975.
Cambridge University Press
New York, N.Y. 10012

HUD Minimum Property Standards, Multifamily Housing Volume 2.
No. 4910.1, 1973 Revision No. 51977
Available from Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Insulation Manual — Homes/Apartments
Available from NAHB Research Foundation, Inc.
P.O. Box 1627
Rockville, MD 20850

Manual of Lumber and Plywood Saving Techniques
Available from NAHB Research Foundation, Inc.
P.O. Box 1627
Rockville, MD 20850

NAHB Performance Guidelines for One and Two Family Dwellings
Available from
National Association of Home Builders, 1978.
Fifteenth and M Streets, N.W.
Washington, D.C. 20005

Performance of a Seven-Zone Residential Hydronic Heating System
ASHRAE Transactions. Harris, W. S. and Fitch, C. H., 1967.
Available from American Society of Heating,
Refrigerating and Air-Conditioning Engineers, Inc.
345 East 47 Street
New York, N.Y. 10017

Principles of Economic Heating, 7th Edition, 1973.
International District Heating Association
Pittsburgh, PA 15206

Principles of Engineering Economy
Grant, Eugene L.; Ireson, W. Grant; and Leavenworth, Richard S., 1976.
Ronald Press Co.
New York, N.Y.

Residential Energy Consumption, Multifamily Housing — Final Report, June 1974
Hittman Associates, Inc.
Available from Department of HUD.
7th & D Streets, S.W.
Washington, D.C.

Total Energy Management, 1977.
National Electrical Manufacturers Association
National Electrical Contractors Association

APPENDIX III

Petroleum Industry Research Foundation, Inc., "Shares of Heating Fuels in U.S. Housing"

PIRINC

Telephone: (212) 867-0052

Petroleum Industry Research Foundation, Inc.
122 EAST 42nd STREET
New York, N. Y. 10017

SHARES OF HEATING FUELS IN U.S. HOUSING

October, 1979

Nationwide, the shares of heating fuels installed in new homes remained relatively stable in 1978 when compared to the data for prior years, according to preliminary figures from the U.S. Department of Commerce.* The shifts in share which occurred in 1978 were continuations of earlier trends, with the electricity share increasing slightly while the gas and oil heat shares decreased slightly in the one-family home market. In the much smaller multi-family home market, the electricity share rose, the gas share fell and the oil share remained the same.

The most important fuel in each of the four Bureau of Census regions remained almost unchanged from 1977 to 1978. In one-family homes, gas is the prime fuel in the North Central region and the West, electricity in the South, and oil in the North East. In multi-family housing, electricity captures the largest share in each region but the North East, where in 1978 oil replaced electricity as the most commonly installed heating fuel.

Overall, completions of one-family homes rose 9% between 1977 and 1978 to 1.4 million units; completions of multi-family units increased by 25% to 0.5 million units. The fastest growth in both single-family and multi-family housing occurred in the South and the West, as shown in the following table:

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*Data will be published in U.S. Bureau of the Census, Construction Report--Series C25, Characteristics of New Housing, U.S. Department of Commerce, Washington, D.C. Data for 1978 subject to revision. Appendix Tables A and B drawn from same source.

HOUSING COMPLETIONS BY REGION, 1978

	Units Completed (000)	Increase from 1977 (%)	Share of U.S. Total (%)
Single-Family			
U.S.	1,369	8.9	100.0
North East	141	4.4	10.3
North Central	300	-	21.9
South	571	11.5	41.7
West	357	14.8	26.1
Units in Multi-family Buildings			
U.S.	498	24.8	100.0
North East	41	-	8.2
North Central	117	18.2	23.5
South	181	44.8	36.3
West	160	20.3	32.1
Total Units			
U.S.	1,868	12.7	100.0
North East	182	3.4	9.7
North Central	417	4.5	22.3
South	752	18.1	40.3
West	517	16.4	27.7

Note: Figures may not add due to rounding. See Appendix Table A for states included in each region.

Source: U.S. Department of Commerce.

As mentioned previously, electricity continues to be the predominant heating fuel for all new housing units in the South, and captures some 60% of the multi-family housing market in the West. Therefore, the rapid growth in housing completions in these regions was an important factor in the nationwide increase in the electric heat share. On the other hand, oil is the dominant fuel only in the North East, whose lagging growth in new home completions has reduced oil heat's share of the national market.

In 1978, some 60% of the single-family homes completed were constructed by speculative builders for resale. The remaining 40% were built either directly by their owners or by contractors on behalf of owners. Because there are many factors that will determine the choice of a heating fuel, it is not surprising that the heating fuel selection of speculative builders varies from that of owner/contractor builders.

In the case of a speculative builder, the most important criterion for heating fuel choice is saleability of the completed homes. The builder must therefore consider the capital cost of the heating system to be installed as well as the acceptability and availability of the fuel to be used. These factors have led to a popularity of gas among speculative builders. Some 80% of the homes constructed by speculative builders were within SMSA's* in 1978, the areas where ready access to existing gas mains is likely highest. As the table on the following page shows, gas captured one-half of this portion of the new home market.

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*SMSA's (Standard Metropolitan Statistical Areas) are designated by the U.S. Department of Commerce and represent areas with a large population nucleus. Most areas outside the SMSA's can be classified as rural.

SHARES OF HEATING FUEL IN SINGLE FAMILY HOMES COMPLETED BY CATEGORY OF BUILDER, 1978

	No. (000)	Share of U.S. Total (%)	Gas (%)	Elec. (%)	Oil (%)	Other (%)
Houses Built For Sale						
Inside SMSA's	670	49	50	43	6	2
Outside SMSA's	168	12	20	74	6	-
Subtotal	839	61	44	49	6	2
Houses Contracted for or Built by the Owner/Occupant						
Inside SMSA's	226	17	31	54	11	4
Outside SMSA's	289	21	23	58	10	10
Subtotal	514	48	26	57	10	7
Total U.S.						
Inside SMSA's	907	66	45	46	8	1
Outside SMSA's	462	34	22	64	8	6
Total	1,369	100	37	52	8	3

The owner/occupant of the home makes the decision among heating fuels for contractor or owner-built homes. Here, it appears that the lower capital cost of electric heat has been a major determinant of fuel choice, as evidenced by the relatively high electric heat share in these homes. The fact that electric heat's operating cost is substantially higher than the operating cost for either gas or oil heat in virtually all areas of the U.S. has therefore apparently been secondary to financial exigencies or other factors at the time the house is constructed. In addition, it is possible that some of these homes are vacation homes used for only a portion of the year, making the cost of heating less significant.

Oil heat got its largest share among the contractor and owner built houses, but even here, its share nationwide is relatively small, reflecting the fact that the oil heat market is geographically far more limited than gas and electricity markets. In the region of oil heat's greatest popularity, the North East, the fuel captured its largest share among houses built for sale, in contrast to the nationwide pattern, and its smallest share among owner-built houses.

The North East

In 1978, the most pronounced changes in heating fuel shares occurred in the North East. In the single family home market, the oil heat share fell markedly--more sharply than in any year since 1971--while electricity rose to account for a portion of the loss. The installation of "other" fuels (wood, for instance) rose substantially, although their share of the market remains relatively small. In the much smaller multi-family home market, the oil heat share increased by 83%. In fact, this sizable increase in the number of new oil-heated multi-family units offset the decrease in the number of new oil heated single family homes. Hence, in both 1977 and 1978, oil heat was installed in approximately 77,000 residential units in the North East. A similar pattern held for the installation of the other major fuels in the region: the numbers of new residential units installing gas heat and electric heat in 1977 and 1978 were essentially the same. Therefore, the increase in total new homes completed in the North East (some 6,000 more in 1978 than in 1977) went to "other" fuels.

The share of "other" fuels in one-family homes rose unusually rapidly last year. The heating fuels which could be included in this category are varied. The figures presented in this memorandum are the results of a survey questionnaire by the Department of Commerce which asks owners or builders to report the "principal" fuel for the residence. Therefore, in installing an airtight wood-burning stove, a homeowner might perceive wood as his principal heating fuel, even though the installation of an additional heat source would be necessary in a region such as the North East. While the proportion of a residence's space heating requirements that can be met by the stove(s) (as against the "auxiliary" system) may be debatable, the homeowner's intention will dictate the answer to the survey question. Similarly, a homeowner installing a solar heating system will likely view it as the principal fuel, regardless of the requirements placed on the back-up system. (Solar heat, however, remains an extraordinarily small portion of the North East's home heating market, by all industry and government reports). In this connection, it should be pointed out that virtually all of the homes for which fuels other than gas, electricity, or oil were reported as the principal fuel were owner-built. In fact, the share of "other" fuels in owner-built homes reached 30% in 1978, reflecting a tripling between 1977 and 1978 of the number of new homes falling into this category in the North East.*

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*In examining these data, it is useful to know that liquefied petroleum gas and bottled gas are included in the totals for "gas." Heat pumps are considered as a type of heating system within the category "electricity."

The North Central

In the North Central region, the gas share of the new single-family home heating market rose in 1978 for the first time since 1971. Throughout the period 1971-1978, however, gas has remained the predominant regional fuel in the one-family home market. In the multi-family home market the electric heat share increased, largely at the expense of oil heat.

The continued strength of gas heat in the region's new housing market is attributable largely to the fuel's popularity with speculative builders, as noted previously in the discussion of the national figures. In homes where the owner made the choice among heating fuels (those which are either contractor-built or owner-built), electric heat was most often installed.

The South and the West

The shares of heating fuels in these large regions did not change substantially, but as noted previously the common use of electricity in these fast growing areas was a major factor in fuel's nationwide growth. In addition, the gas share fell in the West's single family home market, where gas maintains its largest regional share.

Price of Heating Fuels

In Appendix Tables C and D, we report estimated prices for fuels in selected cities. In general, the price of electricity is highest on a dollar per million BTU basis, followed by oil and then by gas, which has the lowest price. Exceptions to this pattern are Seattle, where the region's dependence on hydroelectric power results in a uniquely low electricity price, and New York-Northeastern New Jersey, where the price of gas exceeds the price of oil. In Boston, the price of gas and the price of oil are nearly equal. The table shows January prices for each reported year. It may be noted that since January 1979, heating oil prices have generally risen more rapidly than gas and electricity rates. Current price relationships between oil and the two other fuels are therefore different from those indicated in the table for the beginning of the year.

APPENDIX TABLE A

SHARES OF HEATING FUELS IN ONE-FAMILY HOMES COMPLETED, BY REGION, 1971-1978

		Number of Homes Completed (000)	Gas (%)	Electricity (%)	Oil (%)	Other (%)
U.S.	1971	1,014	60	31	8	1
	1972	1,143	54	36	8	1
	1973	1,174	47	42	10	1
	1974	932	41	49	9	1
	1975	866	40	49	9	2
	1976	1,026	39	48	11	2
	1977	1,258	38	50	9	2
	1978(P)	1,370	37	52	8	3
North East*	1971	134	42	25	31	2
	1972	149	37	30	32	1
	1973	155	34	29	35	3
	1974	131	29	39	32	1
	1975	113	24	33	41	3
	1976	120	15	31	51	3
	1977	135	17	31	49	3
	1978(P)	141	16	34	42	8
North Central*	1971	208	78	12	9	1
	1972	231	74	16	10	1
	1973	255	61	26	13	1
	1974	217	51	36	12	1
	1975	215	49	38	9	4
	1976	270	48	40	10	2
	1977	300	46	40	10	4
	1978(P)	300	50	36	11	4
South*	1971	467	48	45	5	2
	1972	524	42	52	4	1
	1973	514	33	59	7	1
	1974	394	28	67	4	1
	1975	358	29	66	4	1
	1976	404	29	64	5	2
	1977	512	27	67	4	2
	1978(P)	571	27	69	3	2
West*	1971	204	78	21	1	1
	1972	239	72	26	-	1
	1973	251	70	29	1	1
	1974	190	65	33	1	1
	1975	181	59	39	-	2
	1976	231	60	40	-	-
	1977	311	57	42	-	1
	1978(P)	357	52	45	-	2

Notes: Percentages may not add to 100 due to rounding. (P): Preliminary

*North East: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.

North Central: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma and Texas.

West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii.

Source: U.S. Department of Commerce. See footnote, page 1.

APPENDIX TABLE B

SHARES OF HEATING FUELS IN UNITS OF MULTI-FAMILY BUILDINGS COMPLETED, BY REGION, 1974-1978

		Number Of Units Completed (000)	Gas (%)	Electricity (%)	Oil (%)	Other (%)
U.S.	1974	760	35	60	4	1
	1975	430	33	59	7	2
	1976	336	33	59	7	1
	1977	399	29	66	5	1
	1978(P)	498	26	68	5	1
North East*	1974	95	28	44	22	6
	1975	69	24	35	34	8
	1976	49	22	42	32	4
	1977	41	22	48	24	6
	1978(P)	41	23	33	44	-
North Central*	1974	152	59	39	1	1
	1975	93	50	49	-	1
	1976	83	46	52	2	-
	1977	99	39	55	6	-
	1978(P)	117	38	60	2	-
South*	1974	344	21	76	2	-
	1975	164	18	78	3	-
	1976	101	18	76	6	1
	1977	125	13	85	2	-
	1978(P)	181	9	89	2	1
West*	1974	170	47	53	-	-
	1975	103	46	53	-	-
	1976	103	42	57	-	-
	1977	133	38	61	-	1
	1978(P)	160	38	59	-	2

Note: Percentages may not add to 100 due to rounding.
(P): Preliminary

*See Appendix Table A for states included in each region.

Source: U.S. Department of Commerce. See footnote, page 1.

APPENDIX TABLE C

INDEX OF THE RETAIL PRICE OF NATURAL GAS AND HEATING OIL IN SELECTED CITIES JANUARY, 1971-1979

(1971=100)

		1973	1974	1975	1976	1977	1978	1979
GAS (for Residential Heating)	(¢/Therm*) 100=							
North East								
Boston	15.7	116	134	162	201	230	218	251
New York-N.E. New Jersey	13.6	122	138	168	221	267	297	343
Philadelphia	14.3	107	120	140	166	178	213	269
North Central								
Chicago-N.W. Indiana	10.2	111	118	140	159	213	224	295
Minneapolis-St. Paul	9.1	118	123	148	158	212	281	322
Detroit	8.7	114	132	155	223	263	301	319
South								
Atlanta	8.2	134	136	148	171	204	239	331
Houston	9.3	108	112	162	240	305	321	NA
Washington, D.C.	13.6	115	118	150	183	236	267	274
West								
San Francisco-Oakland	7.1	118	129	181	214	237	239	254
Seattle	11.6	110	132	163	209	246	260	316
HEATING OIL (No. 2)	(¢/Gallon) 100=							
North East								
Boston	19.8	105	166	203	215	228	255	279
New York-N.E. New Jersey	19.7	106	187	203	221	242	261	294
Philadelphia	19.8	98	158	192	207	228	251	278
North Central								
Chicago-N.W. Indiana	18.1	103	175	187	219	240	268	300
Minneapolis-St. Paul	17.8	102	195	200	223	252	271	287
Detroit	18.6	103	163	192	215	240	266	291
South								
Washington, D.C.	19.6	101	170	195	214	240	261	286
West								
Seattle	22.0	101	152	186	204	215	231	245

*1 Therm = 100,000 BTU

Source: Computed from U.S. Bureau of Labor Statistics data.

APPENDIX TABLE D

RETAIL PRICES OF FUELS IN SELECTED CITIES, JANUARY 1978 AND 1979

($/Million BTU)

GAS (for Residential Heating)	1978	1979
North East		
Boston	3.42	3.94
New York-N.E. New Jersey	4.05	4.68
Philadelphia	3.05	3.85
North Central		
Chicago-N.W. Indiana	2.31	3.01
Minneapolis-St. Paul	2.56	2.94
Detroit	2.63	2.78
South		
Atlanta	1.97	2.73
Houston	2.98	NA
Washington, D.C.	3.64	3.73
West		
San Francisco-Oakland	1.71	1.82
Seattle	3.02	3.67
ELECTRICITY (for All-Electric Homes)		
North East		
Boston	13.97	11.92
New York	16.55	17.02
Philadelphia	10.91	10.75
North Central		
Chicago	8.17	8.87
Minneapolis	9.60	9.61
Detroit	11.47	13.66
South		
Atlanta	10.18	10.07
Houston	8.00	9.87
Washington, D.C.	9.28	10.40
West		
Los Angeles	11.23	12.01
San Francisco	8.42	9.21
Seattle	3.98	4.32
HEATING OIL (No. 2)		
North East		
Boston	3.63	3.98
New York-N.E. New Jersey	3.71	4.18
Philadelphia	3.58	3.97
North Central		
Chicago-N.W. Indiana	3.50	3.92
Minneapolis-St. Paul	3.48	3.71
Detroit	3.54	3.91
South		
Washington, D.C.	3.70	4.04
West		
Seattle	3.66	3.88

Source: Oil and gas computed from U.S. Bureau of Labor Statistics data; electricity computed from Edison Electric Institute data.

APPENDIX IV

Edison Electric Institute Comments on 10 CFR Part 435, Energy Performance Standards for New Buildings; Proposed Rulemaking

EDISON ELECTRIC INSTITUTE The association of electric companies
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April 29, 1980

Joanne Bakos
Office of Conservation and Solar Energy
U. S. Department of Energy
Docket Number CAS-RM-79-112
Mail Station 6B025
1000 Independence Avenue, S.W.
Washington, D. C. 20545

Subject: 10 CFR Part 435, Energy Performance Standards for New Buildings; Proposed Rulemaking

Edison Electric Institute (EEI) hereby submits its written comments on the above mentioned proposed rulemaking. Edison Electric Institute is the association of the nation's investor-owned electric utilities. Its members serve 99.6 percent of the customers serviced by the investor-owned segment of the industry. They generate more than 77 percent of all the electricity in the country and serve more than 77 percent of all the ultimate customers with electricity.

EEI and its member companies are disappointed in the proposed rule and feel that very little has changed since we commented on the advanced notice of proposed rulemaking. Even after the expenditure of inordinate amounts of money, manpower and time, as well as the volumes of research performed under contract for the Department of Energy, the proposed rule still contravenes the intent of Congress and will have the exact opposite effect on energy conservation dictated by our national energy policies because it encourages the increased use of imported oil and natural gas.

One of the primary concerns is with the inclusion of weighting factors which we feel are biased against the use of our indigenous natural resources through the capabilities of the electric utility industry. These factors, which we are expected to accept as a new economic approach to weighing the cost of fuels to the nation, were supposed to be completely different and derived from an entirely different data base than the old RUFS and RIFS. However, in examining the manner in which weighting factors are to be used, we find that, except for some minor changes in the second decimal place, they are exactly the same as the old RUFS and RIFS, which the Department has rejected as unworkable. We submit that weighting factors are just as unworkable as RUFS and RIFS.

The use of weighting factors is nothing more than an attempt to specify a national fuel selection procedure that dictates the increased use of imported oil and natural gas at worst and discourages the use of electricity at best.

The agency admits the use of weighting factors will not affect the overall energy savings achieved by the standards; therefore, they are not rationally related to the Congressional objective of reducing the "large amounts of fuels and energy . . . consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings. . . ." ECPA §302(a)(1). Moreover, since DOE also admits that the use of weighting factors will not affect building designs, it is equally obvious that they will not further the Congressional objective of insuring that new buildings contain "adequate energy conservation features." ECPA §§302(a)(1),(3) and (4) and 302(b)(1). Finally, the use of weighting factors will not insure "the maximum practicable improvements in energy efficiency . . ." ECPA §302(b)(2). Despite Congress' clear direction that the standards encourage the design of energy efficient buildings, DOE has, instead, concerned itself solely with the economic efficiency of new buildings. DOE also admits in the NOPR that "the same overall (source) energy savings could be achieved (without the use of weighting factors)." NOPR at 2-41. DOE chose to use weighting factors, however, solely to "influence the mix of fuel types saved." Id. Moreover, the particular weighting factors were chosen so that designers using them will be "more likely to reduce electricity" in new buildings. Id. Thus, DOE's use of weighting factors has transformed BEPS into an energy management program explicitly directed at discouraging the use of electricity in new buildings in favor of oil and natural gas.

The President in his 1977 National Energy Plan ("NEP") articulated specific energy management policies. Congress has done the same in the numerous pieces of energy legislation it has enacted since 1973, including ECPA, the National Energy Conservation Policy Act ("NECPA"), the Public Utility Regulatory Policies Act ("PURPA") and the Powerplant and Industrial Fuel Use Act ("PIFUA"). In general, these policies emphasize the critical importance of reducing the Nation's use of oil and natural gas and of increasing the Nation's use of its abundant coal supplies and alternative energy sources, in particular, solar and hydro power. The energy management policies of the President and Congress specifically encourage the substitution of coal, including electricity generated from coal, for oil and natural gas use. Significantly, the President noted that while the Nation's total energy use might rise as a result of substituting oil and natural gas with electricity generated from coal (because of the inefficiencies inherent in electrical generation), "conserving scarce oil and natural gas is more important than saving coal" (emphasis added). NEP at 31. In PIFUA Congress strongly encouraged industry and utilities to substitute the use of coal and alternate fuels for the use of oil and gas wherever feasible. BEPS, however, will undermine utilities' efforts to manage their electric loads more effectively by encouraging designers to forego the use of electricity wherever possible, especially for space heating. Electricity will still be used, though, for air-conditioning and for other building systems. Since most utilities currently experience their peak loads during the summer, those peaks will increase, in both absolute terms and relative to winter off-peak loads. To the extent utilities can level out their loads, however, they can spread their capital costs over a larger energy sales base and, therefore, lower the per-unit cost of electricity to the consumer.

The proposed rule as written is in direct opposition to the above stated intent of Congress and the purpose and direction of the administration's expressed energy conservation goals.

These comments have been developed after an exhaustive study of the NOPR, the ten technical support documents and numerous other reports that have formed the basis for the Building Energy Performance Standards.

The comments are organized into several sections in addition to this introductory section. Each section attempts to focus on a particular area of concern. There is, unfortunately but necessarily, a modest amount of duplication of thought because of the many interrelationships associated with various BEPS elements. To enable the reader to locate subject areas of interest, the following guide is offered:

Subject Page

Statutory Authority 6
Administrative Law Issues 37
Weighting Factors 58
Commercial Energy Budget Levels 96
Life Cycle Costing 114
Standard Evaluation Technique 132
Standard Building Operating Conditions 146
Summary 155

STATUTORY AUTHORITY

The sole grant of authority to DOE for the development of BEPS is contained in the Energy Conservation Standards for New Buildings Act of 1976, which was enacted as Title III of the Energy Conservation and Production Act ("ECPA"), Pub. L. 94-385, 42 U.S.C. §§ 6831-6840, and the Department of Energy Organization Act, ("DOEA") Pub. L. 95-91, 42 U.S.C. §§ 7701 et seq. In ECPA, Congress determined that significant amounts of energy were unnecessarily consumed for end-uses in buildings, specifically for heating, cooling, ventilating, and providing domestic hot water. To eliminate that energy waste, Congress issued a clear mandate to DOE to develop energy performance standards that would increase the energy efficiency in and of new buildings. BEPS were to be the centerpiece of an energy conservation program "designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy" in new buildings. Congress required the establishment of performance standards that would set energy consumption goals for buildings, without specifying the means to reach those goals.

Despite this clear mandate, the performance standards proposed by DOE exceed the authority delegated by Congress in ECPA in five essential respects:

1. They create a fuel selection program rather than the energy conservation program Congress intended.
2. They regulate energy consumption outside the building line rather than energy consumption at the building site.
3. They minimize, rather than maximize, the energy efficiency in and of new buildings.

4. They specify methods of compliance rather than general consumption goals.

5. They unlawfully regulate energy consumed by lighting, exhaust fans, elevators and escalators in commercial and multi-family residential buildings.

What follows is a more detailed discussion of each of the above points that will clearly show that BEPS, as proposed, are beyond the scope of authority granted to DOE in ECPA.

A. The Proposed BEPS Create A Fuel Selection Program Rather Than The Energy Conservation Program Congress Intended

In the Energy Conservation and Production Act, Congress issued a clear mandate to DOE to eliminate energy waste through the development of energy conservation standards. As the focal point of Congress' conservation program, the standards were "to achieve the maximum practicable improvements in energy efficiency" and " to assure that reasonable energy _conservation_ features will be incorporated into new commercial and residential buildings." (emphasis supplied). ECPA §§ 302(b)(1) and (2). DOE, however, through the incorporation of so-called "weighting factors," has based the standards on factors wholly unrelated to either energy conservation or energy efficiency in new buildings. As we will show, DOE has transformed BEPS into a fuels selection program in clear violation of the mandate given by Congress in ECPA.

1. DOE has proposed fuel selection standards

The proposed BEPS are, in reality, nothing more than national fuel selection standards that dictate the increased use of oil and natural gas at worst and discourage the use of electricity at best. The fatal flaw in DOE's regulatory scheme is the adoption of weighting factors, which are used "as a way of expressing the Design Energy Budget [and Design Energy Consumption] of a building design." NOPR at 2-37. Weighting factors are based on "the relative 'value' of the different fuels to the Nation, expressed in terms of (1) fuels prices, and (2) explicit national policy determinations of nonmarket values associated with specific fuel types." TSD No. 4 at 1. Their stated purpose is to encourage building designers to make "fuel choices that reflect how the Nation values various forms of energy." NOPR at 2-36. Weighting factors will thus be "important in influencing a designer to save one or another type of fuel when faced with that option during the design process" and, as a result, "will influence the mix of fuel types saved." Id. at 2-39,41.

More importantly, DOE admits that "the relative effort spent on conserving different fuels depends on the weighting factors chosen." TSD No. 4 at 8. The rationale behind this statement is made even clearer by the following explanation:

> Appropriate weights for electricity and gas. . . would make the designer's choice consistent with energy goals. A weight for electricity reflecting the fact that it is more valuable (in this case, by a factor of 3:1) than a Btu of gas, would give him appropriate credit for saving electricity. Here, every single Btu of electricity saved would reduce the house's design energy by 3 (weighted Btu's), while a Btu of gas saved would still only count as a reduction of a single unit in meeting the requirements of the Standards. Id. at 13.

This "credit," DOE contends, is necessary to encourage designers to conserve energy "in a manner consistent with the value to the Nation of saving different nonrenewable fuels." NOPR at 2-39. In reality, however, the weighting factors were carefully chosen so that designers using them will be "more likely to reduce electricity" in new buildings. Id. at 2-41.

Weighting factors -- aside from dictating the designer's fuel selection -- have no other purpose. DOE admits that weighting factors will not affect most well-designed buildings. TSD No. 4 at 4, NOPR at 2-39. Moreover, DOE admits that weighting factors will have no effect whatever on the "overall (source) energy savings" achieved by the standards. NOPR at 2-41. Indeed, the single justification offered by DOE for weighting factors is that they will "influence the mix of fuel types saved." Id. The only rational explanation for the adoption of weighting factors is that DOE has, by design, created a nationwide fuels management program. In so doing, DOE has seriously misinterpreted its mandate in ECPA to reach a result Congress never intended.

2. ECPA does not authorize a fuels selection program

ECPA is completely devoid of any authority for the creation of a fuels selection program. A careful review of the language of Title III of ECPA as well as its legislative history reveals that Congress never intended to differentiate between energy forms conserved in new buildings. As demonstrated below, Congress was concerned solely with the overall amount of energy conserved in new buildings, not with

best copy available

the mix of fuel types saved.

The clear purpose of Congress in ECPA was to establish levels of energy efficient design for new residential and commercial buildings rather than establish a fuels selection program. This intent is reflected in the express purposes of Title III, namely to:

> (1) redirect Federal policies and practices to assure that reasonable energy conservation features will be incorporated into new commercial and residential buildings receiving Federal financial assistance;
>
> (2) provide for the development and implementation, as soon as practicable, of performance standards for new residential and commercial buildings which are designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy; and
>
> (3) encourage States and local governments to adopt and enforce such standards through their existing building codes and other construction control mechanisms, or to apply them through a special approval process. (emphasis supplied). ECPA § 302(b).

The chief concern of Congress was the development, adoption and enforcement of energy conservation standards that would maximize energy efficiency in new buildings through incorporation of reasonable energy conservation features. In other words, Congress was concerned with how buildings perform, not what they perform with.

Nowhere in ECPA does Congress express or imply any preference for saving one particular form of energy over another. Although the use of nondepletable sources of energy is encouraged, Congress did not differentiate between depletable energy sources conserved. Certainly, neither ECPA nor its legislative history contains any express or implied congressional preference for saving electricity over oil and natural gas. Thus, in blindly persisting in transforming BEPS into a fuels selection program, DOE has severely misconstrued the intent of Congress in ECPA.

Further evidence of the fact that Congress never envisioned the creation of a fuels selection program is found in section 309 of ECPA. There, Congress directed DOE to:

> consult with appropriate representatives of the building community (including representatives of *labor* and the *construction industry*, *engineers*, and *architects*), with appropriate *public officials* and organizations of *public officials*, and with representatives of *consumer groups*." (emphasis supplied.)

Conspicuous by its absence is any mention of the oil, gas, or electrical industries. It is simply inconceivable that Congress would have overlooked these groups if it had contemplated the development of fuel selection standards that would strike at the heart of these very industries.

3. *Congress envisioned an energy conservation program*

Congress had something vastly different than a fuels selection program in mind when it enacted ECPA. Nowhere is this more evident than in the legislative history of the statute itself. The report from the House Committee on Banking, Currency and Housing on H.R. 8650 clearly states that the intent of Congress was "to introduce *construction standards* that will reduce significantly the levels of energy consumption occurring as a result of *prevailing construction* practices" (emphasis added). House Report No. 94-377 at 2. Similarly, in the floor debate on H.R. 8650 in the House, Representative Reuss, a manager for Title III, explicitly stated that the objective of Congress was "to encourage the introduction of construction standards that will reduce significantly the levels of energy consumption occurring in those buildings". (emphasis added). 121 Cong. Rec. H. 8412 (daily ed. Sept. 8, 1975). Finally, in the floor debate on the conference report to H.R. 12169, Senator Brooke observed that: "new construction could be built so energy efficient that new structures would consume 50 to 80 percent less energy in day-to-day operations than existing buildings now use." 122 Cong. Rec. S. 13536 (daily ed. Aug. 5, 1976). This savings, he pointed out, could be accomplished by the use of advanced energy technologies in construction, adequate insulation and improved heating and cooling systems. In short, Congress was concerned with the development of construction standards only.

Further, the report from the House Committee on Banking, Currency and Housing states that "thermally efficient buildings can significantly reduce energy consumption and demand for fuels." House Rep. No. 94-377 at 7. In the same vein, Representative Maguire, a manager for Title III, in a floor debate in the House on H.R. 12169, pointed out that "important savings can be achieved by strict insulation standards for new buildings." (emphasis supplied) 122 Cong. Rec. H. 8583 (daily ed. Aug. 10, 1976). This opinion was echoed by other members of Congress. Representative Wylie, for example, in the floor debate in the House on H.R. 8650, noted that:

> After considerable committee debate, an approach was adopted that stresses energy saving insulation performance factors . . . (emphasis supplied). 121 Cong. Rec. H. 8417 (daily ed. Sept. 8, 1975)

The clear implication of these remarks is that Congress was concerned exclusively with construction or insulation standards -- a concern which could hardly be said to embrace DOE's proposed fuel selection standards.

In fact, the legislative history of ECPA reveals that Congress rejected the notion of fuel selection standards. In a colloquy between Representatives Sheuer and Brown in the floor debate in the House on H.R. 8650, this point was made quite clear. Representative Sheuer asked:

> Is there anything in this bill that encourages stationary energy users to shift from gas and oil consumption for heating and air-conditioning purposes to coal as their source of energy for heating and cooling?

Representative Brown responded:

> As the gentlemen knows, Title I is just a program for insulation, for weatherization. Title II deals with the building standards, energy conservation, construction standards. It does not really direct itself to the question of types of energy being utilized. (emphasis supplied).

Representative Sheuer then added:

> I applaud the purpose of the bill to support weatherization and insulation as important steps to an energy conservation program, but I regret that there is not a specific tool to encourage and support the conversion of stationary energy users from oil and gas, which are in desperately short supply, to coal, of which we have many, many hundreds of years' supply, in order to lessen our dependence on foreign oil sources.
> (emphasis supplied) 121 Cong. Rec. H. 8415 (daily ed. Sept. 8, 1975)

This exchange clearly demonstrates that Congress never even considered, let alone authorized, the development of a fuels selection program.

There is simply no authority whatever in the legislative history of ECPA for the development of a fuels selection program. Such a program is alien to the basic legislation -- it has absolutely nothing to do with either energy conservation or energy efficiency in new construction. Stated simply, DOE cannot base the standards on factors totally unrelated to the congressional purpose in ECPA.

4. Congress' choice of building codes is inconsistent with the development of a fuels selection program

Congress' choice of State and local building codes as a vehicle for implementing BEPS clearly indicates that it neither intended nor authorized DOE to incorporate a fuels selection program in BEPS. Instead, Congress envisioned that "State and local building codes or similar controls [could] provide an existing means by which to assure . . . that newly constructed buildings contain adequate conservation features" (emphasis added). ECPA § 302(a)(4). Indeed, the choice of building codes is consistent only with an intent to implement construction standards. Thus, it would be irrational to assume that Congress would employ building codes to implement fuel selection standards.

Traditionally, building codes have been concerned with how a building is built and with the materials out of which it is built -- in other words, construction methods and materials. See generally 13 Am. Jur. 2d, Buildings §§ 2-31. Moreover, building codes are distinctly local in scope, nature and purpose in order to deal effectively with local circumstances. As such, they are ideal vehicles for assuring that energy-conserving features such as glazing, insulation, and more efficient heating, cooling, ventilating and hot water systems are incorporated into new buildings. Conversely, the inherent characteristics which make them particularly well suited to ensure energy conservation in new construction, make them totally unsuited to deal with such complex national issues as the pricing and allocation of our scarce national resources. Furthermore, the local officials who administer the building codes do not have the experience necessary to administer a national fuels management program. In short, building codes are neither designed for, nor are local officials capable of, handling complex national as well as international energy problems.

In sum, DOE has exceeded its statutory authority by proposing fuel selection standards designed to act as surrogates for our national pricing and resource allocation policies and as a method to reconfigure the Nation's use of fuels and energy through State and local building codes.

B. ECPA Does Not Authorize DOE To Promulgate Source-Based Performance Standards

In the Energy Conservation and Production Act, Congress delegated authority to DOE to promulgate performance standards for new buildings that are designed to maximize energy efficiency and reduce the wasteful end-use of fuels and energy in new buildings. DOE, however, has misinterpreted Congress' mandate by incorporating in BEPS weighting factors (virtually identical to the now-discarded resource utilization factors) which base the standards on extraneous considerations of energy consumption away from the building site -- or "source energy." As we will show, DOE's development of source-based performance standards clearly exceeds Congress' delegation of authority to regulate energy consumption in new buildings.

Weighting factors are the successors to the "source energy" concept first adopted in the Advance Notice of Proposed Rulemaking ("ANPR") on BEPS published by DOE in November 1978. There, DOE incorporated in BEPS resource utilization factors ("RUFs") to account for "the energy required to convert and transport raw energy from its source to the building line." ANPR at 13. According to DOE, source-based standards account "for not only the Btu's of energy used within the building but also the energy consumed in refining, converting and transporting raw energy into delivered energy at the building site." NOPR at 2-33.

1. DOE has proposed source-based performance standards

The proposed BEPS are, in fact, source-based standards. DOE specifically admits that:

> the physical considerations of source energy were combined with price and policy considerations in developing the economic weighting factors . . . . To the extent that prices reflect the scarcity of energy resources, economically based weighting factors act much as RUFs . . . [T]he use of economically based weighting factors has limitations that are similar in nature to the difficulties in determining the RUFs . . . in a physically based scheme . . . [i.e., the problem of] what to count as energy losses (emphasis supplied). TSD No. 4 at 7-8.

Indeed, DOE explicitly rejected standards that would "effectively value all forms of energy equally at the building line." NOPR at 2-35. Moreover, DOE acknowledges that "the values of the weighting factors compare favorably to the source energy factors" and, therefore, the weighted energy budgets selected for the proposed rule "are not significantly different" from the source energy budgets analyzed in the agency's Economic Analysis. TSD No. 8 at 2-1. But, as we demonstrate below, Congress never intended to extend the scope of BEPS beyond the building site.

The beginning and end of any search for DOE authority to promulgate source-based performance standards for new buildings is ECPA. Unless that statute can be found to have delegated authority to DOE to extend the scope of the BEPS beyond the building line, no basis in law can exist for the development of source-based standards. DOE concedes half of the obvious in its self-serving construction of the statute:

> The language of the Energy Conservation and Production Act (the Act) (Pub. L. 94-385, 42 U.S.C. 6831 et. seq.) is general, requiring the "maximum practical improvement in energy efficiency and increases in the use of nondepletable sources of energy. Taken literally, the maximum practicable level of energy conservation could be taken to mean that which reduces the total U.S. consumption of all energy to the greatest extent. For the Nation, energy consumption is measured in terms of "source energy" . . . (emphasis supplied). TSD No. 4 at 7.

Yet DOE admits, in the same breath, that "many designers are accustomed to thinking about energy use in terms of the energy required at the building boundary. Because the Energy Budget Levels . . . are calculated using weighting factors, the values may not be familiar." (emphasis supplied) NOPR at 2-39. This approach is equally unfamilar to Congress, which like the design community has never considered energy consumption by buildings in source energy terms. But, since the authority to enlarge the narrow concept of site-based performance standards depends both legally and logically on the statute itself, DOE's strained construction of ECPA reflects its inability to confront the pivotal issue in this rulemaking: there has never been any statutory authority to promulgate source-based standards.

2. ECPA does not authorize source-based performance standards

What this argument will show is that the ECPA -- whether construed narrowly or broadly, whether examined solely on its face or in light of its legislative history, and whether or not building codes are studied as an aid to interpretation -- wholly fails to grant essential authority to DOE to regulate source energy use. As the Supreme Court has pointed out, "[n]either we nor the Commissioner may rewrite the statute simply because we may feel that the scheme it creates could be improved upon." (emphasis supplied). United States v. Calamaro, 354 U.S. 351, 357 (1957). Feelings aside, ECPA does not confer on DOE the power to make law but rather "the power to adopt regulations to carry into effect the will of Congress as expressed by the statute." (emphasis supplied). Ernst & Ernst v. Hochfelder, et al., 425 U.S. 185, 214 (1976), quoting Dixon v. United States, 381 U.S. 68, 74 (1965), quoting Manhattan General Equipment Co. v. Commissioner, 297 U.S. 129, 134 (1936).

Section 304(a)(1) and (2) of Title III of ECPA contain the basic grant of authority to DOE to promulgate BEPS. The delegation involved is narrow and specific. It directs DOE to promulgate performance standards for new commercial and residential buildings which must take into account climatic conditions throughout the country. "[T]he general rule applied to statutes granting powers to [administrative agencies] is that only those powers are granted which are conferred either expressly or by necessary implication." 2A Sutherland, Statutes and Statutory Construction, § 65.02 (4th ed. 1972).

Since it is clear that ECPA does not expressly refer to source energy, authority, if any, to regulate source energy consumption must somehow be embedded in the phrase "performance standards." To understand why Congress determined that performance standards were necessary -- as well as the specific issues the standards were to address -- the express findings and purposes of Title III of ECPA must be examined.

No other sections of ECPA bear on this threshold issue of defining statutory authority. If DOE's claim of authority is to carry any weight, it must be grounded in the assumption, either explicit or implicit, that source-based performance standards are statutorily and functionally identical to site-based standards, and are therefore within the contemplation of ECPA. That assumption, upon which the claim of authority stands or falls, is manifestly false.

At the outset, we must examine the language of Title III for "'[t]he starting point in every case involving construtien of a statute is the language itself.'" Ernst & Ernst, supra, at 197, quoting Blue Chip Stamps v. Manor Drug Stores, 421 U.S. 723, 756. See, also, Flora v. United States, 357 U.S. 63, 65 (1958). In analyzing the language, words must be given their "plain meaning". On this point, the Supreme Court has held that "the plain, obvious and rational meaning of a statute is always to be preferred to any curious, narrow, hidden sense . . . ." (citation omitted). Old Colony R. Co. v. Comm'r of Internal Revenue, 284 U.S. 552, 560 (1932).

In Section 302(a)(1) of Title III, Congress found that unnecessary amounts of fuel and energy were consumed in heating, cooling, ventilating and providing hot water for new buildings because those buildings lack adequate energy conservation features. Obviously, the plain meaning of the words "consumed in" is the end-use consumption at the building site. Placed in context, those words clearly refer to fuels and energy consumed in specified building systems. It would be absurd to construe the phrase "consumed in a building" to encompass energy consumed in extracting energy from its source, converting it to other types of energy and transmitting it to the building site. Here, the language is plain, unambiguous and uncontrolled by other sections of the statute.

Any doubt as to the plain meaning of those words is removed when the reason for the unnecessary consumption is considered, namely, "because such buildings lack adequate energy conservation features" (emphasis supplied). In other words, if buildings -- not electric utilities, oil and gas wells, powerlines or pipelines -- contained adequate conservation features, large amounts of fuels and energy would not be unnecessarily consumed each year. Thus, clearly expressed in each of the findings of ECPA is Congress' concern with BEPS that would ensure that "newly constructed buildings contain adequate energy conservation features." (emphasis supplied). ECPA § 302(a)(4).

Viewing the purposes of Title III in light of those congressional findings, we cannot find any expressed or necessarily implied provisions or language that purports to authorize the development and implementation of source-based performance standards for new buildings. Indeed, the restricted purpose of ECPA is evidenced in Section 302(b)(1) which directs that "reasonable energy conservation features . . . be incorporated into new commercial and residential buildings receiving Federal financial assistance." (emphasis supplied). As with the findings of the statute, this first purpose clearly fixes the limits of Congress' concern at the building line.

The second purpose of Title III is broader -- but no less directed -- than the first. It provides that the standards for new buildings should be "designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy." ECPA § 302(b)(2). Placed in context, the term "energy efficiency" necessarily relates to the essential purpose of the statute, that is, to design and construct energy efficient buildings. In this light, it is clear that Congress set the goal of energy efficiency in order to reduce energy waste in new buildings. Congress clearly intended that BEPS improve -- to the maximum extent practicable -- the on-site efficiency of the building envelope as well as the four primary systems within the building itself.

The second purpose of Title III also provides that BEPS should encourage the use of nondepletable sources of energy in new buildings. This purpose is wholly consistent with the congressional mandate to develop and implement site-based performance standards. Certainly this objective provides no basis for enlarging the narrow concept of BEPS to encompass considerations far removed from the building site.

Finally, the third purpose of Title III is to encourage the adoption and enforcement of BEPS through State and local "building codes and other construction control mechanisms" (emphasis supplied). ECPA §302(b)(3). Just as Congress' choice of State and local building codes as the the vehicle for ensuring that new buildings contain adequate energy conservation features is inconsistent with the establishment of a fuels selection program, that choice is also inconsistent with a program to regulate fuels and energy consumed away from the building site. Indeed, the choice of building codes is consistent only with an intent to reduce the end-use consumption of fuels and energy within the building perimeter. For example, building codes could not increase the efficiency of generating and transmitting electricity -- or any other fuel -- to the building site. It is a well established legal principle that statutes must not be construed to produce absurd results unrelated to congressional purpose. Thus, it would be irrational to assume that Congress would employ building codes to conserve fuels and energy expended outside the building line.

Finally, if the scope of BEPS is extended beyond the building line, as proposed by DOE, it would render the express findings and purposes of the statute meaningless. The essential problem with a broader coverage is that once BEPS depart from the
building site, there is no logical stopping point. Certainly, Title III provides no clues as to where such a point may lie.

One of the cardinal principles of statutory construction is that "the law favors a rational and sensible construction." Sutherland, Statutes and Statutory Construction, § 45.12 (4th ed. 1972). Thus, any attempt to extend BEPS beyond the building line not only exceeds Congress' delegation of authority, but violates that rule of statutory construction.

3. The legislative history of ECPA refutes the existence of any authority to develop source-based standards

Where, as here, the words of the statute are clear and unambiguous, there is no need to examine the legislative history. However, in order to remove any lingering doubt as to the intent of Congress, a brief look at the legislative history of Title III is warranted.

In the floor debate in the Senate on H.R. 12169, Senator Hollings, a manager for Title III, stated that:

> "Conservation is our most important short range energy option. With respect to new buildings, this bill establishes performance standards for new buildings, discouraging building designs which waste energy. This is a critical element of our national energy conservation program." (emphasis supplied). 122 Cong. Rec. S. 13556 (daily ed. Aug. 5, 1976).

He further noted that Titles III and IV "mesh well with the energy conservation tax credits now before the Senate." *Id.* at 13557. As a manager for Title III, Senator Hollings' statements are especially significant. See, e.g., Ernst & Ernst, supra at 203. His remarks reflect a clear concern with the on-site consumption of energy, namely, that building designs waste energy. Moreover, the specific mention of tax credits in this context refers to building improvements such as insulation, storm doors and windows, etc., all of which are aimed at reducing on-site energy use. Such improvements relate directly to Congress' belief that "thermally efficient buildings can significantly reduce energy consumption and demand for fuels . . . " (emphasis supplied). House Rep. No. 94-377 at 7.

Senator Kennedy, who with Senator Hollings sponsored the June 16, 1976 floor amendments which, *inter alia*, added Title III to H.R. 12169, noted that:

> "[t]he provisions of this legislation offer a comprehensive approach to eliminating waste of energy in heating and cooling homes, apartments, commercial buildings and factories. (emphasis supplied). 122 *Cong. Rec.* S. 13558 (daily ed. Aug. 5, 1976)

Here again, the source of energy waste was tied to heating and cooling buildings rather than to generating and transmitting energy to the building site.

Further, the history of H.R. 8650 also reflects Congress' concern solely with the conservation of energy within the building perimeter. For example, the report from the Senate Committee on Banking, Housing and Urban Affairs, 94th Cong. 2d Sess., No. 94-623, states that Title III "is designed to reduce energy consumption in new dwellings and commercial buildings in the Nation." (emphasis supplied). Sen. Rep. at

5. Similarly, the report from the House Committee on Banking, Currency and Housing, 94th Cong. 1st Sess., No. 94-377, states that the objective of Title III was "to introduce construction standards that will reduce significantly the levels of energy consumption occurring as a result of prevailing construction practices" (emphasis supplied). House Report at 2. Again, Congress's concern with the large amounts of energy consumed in buildings was focused on causes -- in this case prevailing construction practices -- having nothing whatever to do with the off-site use of energy.

Finally, in the floor debate in the House on H.R. 8650, Representative Reuss, a manager for Title III, stated that the intent of Congress was "to encourage the introduction of construction standards that will reduce significantly the levels of energy consumption occurring in those buildings". (emphasis supplied). 121 Cong. Rec. H.R. 8412 (daily ed. Sept. 8, 1975). The concern of Congress was thus unmistakabe: (1) buildings consume too much energy; (2) that consumption occurs in buildings; and (3) the introduction of construction standards would significantly reduce the amount of energy consumed in new buildings. In short, by extending the scope of BEPS beyond the building site, DOE "would add a gloss to the operative language of the statute quite different from its commonly accepted meaning." Ernst & Ernst, supra at 199.

4. The efficiency of electrical generation and transmission was addressed in Title II of ECPA

Not only does the plain statutory language wholly refute the existence of any authority for DOE to regulate source energy consumption, but related congressional action in Title II of ECPA -- "Electric Utilities Rate Design Initiatives" -- also confirms the clear absence of any such authority. There, Congress directly addressed the very problem DOE is now seeking to regulate indirectly, i.e., the generation and transmission of electricity to the building site. In Title II Congress sought to provide for the development and implementation of: (1) load management techniques which are cost effective; (2) rates which reflect marginal cost of service, or time of use of service, or both; (3) ratemaking policies which discourage inefficient use of fuel and encourage economical purchases of fuel; and (4) rates (or other regulatory policies) which encourage electric utility system reliability. Congress was concerned with conserving energy resources, reducing the need for new electric generating capacity, reducing demand for capital by electric utilities, and reducing the cost of electricity to consumers.

Those concerns are clearly reflected in the remarks of Representative Moffett, a manager for Title II:

> There is a consensus developing throughout this country that there is an enormous potential for conservation through redesign of utility rates, adoption of peak load prices, and other load management techniques.

In the Public Utility Regulatory Policies Act ("PURPA"), Pub. L. No. 95-617 16 U.S.C. §§ 2601 et. seq., which was enacted as part of President Carter's National Energy Act, Congress implemented the goals of Title II by encouraging, inter alia, utilities to make the most efficient use of their generating facilities. Since the enactment of PURPA, DOE has developed a comprehensive policy to achieve those objectives.

Title II and Title III of ECPA must be read together under the rules of statutory construction:

> A statute is passed as a whole and not in parts or sections and is animated by one general purpose and intent. Consequently, each part or section should be construed in connection with every other part or section so as to produce a harmonious whole. 2A Sutherland, Statutes and Statutory Construction, § 46.05 (4th ed. 1972)

Having carefully defined the purpose of Title II, it is inconceivable that Congress also intended to implicitly delegate to DOE in Title III the authority to indirectly regulate in this same area. Such a result would violate the presumption that Congress has a definite -- and in this case exclusive -- purpose in every section of the statute. Id. Explicit congressional action in Title II necessarily precludes the assumption of implicit congressional action in Title III. Moreover, it refutes the existence of any authority for DOE to regulate in BEPS source energy consumption by electric utilities. Thus, in straining to reach an interpretation of authority not clearly compelled by law, DOE has acted arbitrarily and capriciously and has abused its administrative discretion.

C. The Proposed BEPS Minimize, Rather than Maximize, Energy Efficiency In New Buildings

In section 302(b)(2) of ECPA, Congress directed DOE to develop performance standards "which are designed to achieve the maximum practicable improvements in energy efficiency" (emphasis supplied) in new buildings. Instead, DOE has proposed BEPS that would actually discourage energy efficiency in new buildings by allowing designers to reduce conservation measures and to waste oil and natural gas. This is a direct result of DOE's decision to adopt weighting factors and to base Energy Budget Levels on life-cycle cost analyses. As we will show, the proposed BEPS frustrate the goal of maximum energy efficiency by establishing disparate performance standards for identical buildings, based exclusively on the form of energy used.

1. The proposed rule encourages inefficient design

Under the proposed rule, a designer using oil or natural gas can design a less efficient and less costly building and still comply with the standards. In almost all of DOE's examples in the NOPR, gas- heated homes can meet the budget levels with less stringent insulation levels, less window glazing, and less efficient hot water heating technology. NOPR at 3-15,16,17. This phenomenon is not limited to heating either -- it will occur whenever a designer switches from any electric component to one using oil or natural gas. The reason is simply that weighting factors and life-cycle costing allow relatively greater inefficiency whenever the designer chooses natural gas or oil. The proposed BEPS thus bring about a result directly contrary to the mandate of ECPA -- they minimize, rather than maximize, the energy efficiency in and of buildings.

2. The proposed BEPS fail to maximize energy efficiency in all buildings

An equally disturbing aspect of the proposed BEPS is their failure to maximize energy efficiency in all new buildings. Based on life-cycle analyses performed for DOE by outside consultants, the agency decided to establish separate energy budgets for single-family residential buildings depending on the energy form used for heating. However, because the separate budgets for residences using oil and natural gas are less stringent than the budgets for residences using electricity, a designer is actually encouraged to design a less efficient residence using natural gas or oil rather than a more efficient residence using electricity.

In effect, DOE has proposed two different sets of standards -- a stringent set for buildings using electricity and a lenient set for buildings using oil or natural gas. This decision is grounded on the false assumption that Congress authorized the design and, more importantly, the construction of an entire group of less efficient buildings. As we show below, however, there has never been any statutory authority to promulgate different performance standards for identical buildings in the same area of the country, based solely on the energy form selected.

In section 303(9) of ECPA, Congress defined the term "performance standards" to mean:

> an energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed in achieving that goal or goals, but including statements of the requirements, criteria and evaluation methods to be used, and any necessary commentary.

That definition is qualified in section 304(b) of ECPA:

> All performance standards . . . shall take account of, and make such allowance or particular exception as the Secretary determines appropriate for, climatic variations among the different regions of the country. (emphasis supplied).

The clear implication of this provision is that Congress intended that the standards account only for variations in climate, not variations in energy forms used.

This critical fact is confirmed by the legislative history of ECPA. In the report from the Senate Committee on Banking, Housing and Urban Affairs, 94th Cong. 2d Sess., No. 94-623, the term "performance standard" is described as:

> a standard which establishes an energy efficiency goal for a particular type of building . . . . For example, a performance standard would require that a particular building consume no more than a stated quantity of Btu's per square foot per year. (emphasis supplied) Sen. Rep. at 6.

The Senate Committee obviously contemplated only one goal for a particular type of building. Moreover, the Senate Committee stated that the standards "would probably because of geographical, climate and other differences vary somewhat by State and local area." Id. at 7. Fuel selection was not mentioned. Similarly, the report from the House Committee on Banking, Currency and Housing, 94th Cong. 1st Sess., No. 94-377, states:

> that a performance standard would require a particular type of building in an area of the country to be designed and constructed to consume less than a specified amount of energy during a given period of time such as a year. (emphasis supplied) House Rep. at 6.

The House Committee plainly intended that identical buildings in the same area would have to comply with the same budget regardless of what energy form is used.

Any doubt as to the intent of Congress is removed by the following exchange in the floor debate in the Senate on H.R. 8650. Senator Stone asked:

> Would the minimum standards set by the Federal agency be applicable to all States or does the senator envision that there would be groups of States, like classified as warm-weather States, or groups of States classified in another way, would the Federal minimum be keyed severally, to each of the 50 States?

Senator Proxmire responded:

> The Federal minimum performance standards would vary by climate. They would take into account the differences in climate among the various States. We recognize that fact. (emphasis supplied). 122 Cong. Rec. S. 3087 (daily ed. Mar. 9, 1976)

Congress' intent was manifestly clear -- the standards would vary only by climate area and building type. Thus, DOE's misguided attempt to promulgate separate performance standards for new buildings based, in large measure, on the energy formed selected clearly exceeds the grant of authority contained in ECPA.

D. The Proposed BEPS Specify Methods of Compliance Rather Than General Consumption Goals

In the Energy Conservation and Production Act, Congress contemplated a "performance," rather than a "prescriptive," approach to energy conservation in new residential and commercial buildings. It directed DOE to develop "performance standards," which are defined in section 303(9) of ECPA to mean:

> an energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed in achieving that goal or goals, but including statements of the requirements, criteria and evaluation methods to be used, and any necessary commentary. (emphasis supplied).

Contrary to this mandate, DOE has proposed BEPS that actually prescribe the "methods, materials and processes" to be used in meeting the standards. As we will demonstrate, DOE has defeated the congressional perference for performance standards in ECPA.

DOE purports to have followed the command of Congress in ECPA:

> The proposed Standards regulate the design of a whole building rather than prescribing requirements for its individual parts. . . The proposed Standards do not specify the methods, materials or processes used to meet the energy goals. As such, they can accommodate changes in design and technology over time. (emphasis supplied). NOPR at 1-4.

This bald statement, however, belies the truth.

The proposed BEPS, through the use of weighting factors and life-cycle costing, force a biased comparison of energy sources. In so doing, they effectively dictate the designer's fuel choice, i.e., natural gas, for a given building. The proposed rule thus narrowly prescribes the options available to the designer in the selection of energy systems. By eliminating the designer's freedom of choice, DOE has in effect specified "the methods, materials and processes" to be used in complying with the standards.

The legislative history of ECPA reveals that Congress rejected the notion of rigid, inflexible standards in favor of a performance approach that would encourage flexibility and innovation in design. For example, the report from the Senate Committee on Banking, Housing and Urban Affairs, 94th Cong. 2d Sess., No. 94-623, describes a performance standard as:

> a standard which establishes an energy efficiency goal for a particular type of building without specifying the means to reach that goal . . . Such a standard would permit different materials and methods of construction to be utilizied in achieving the overall performance goal, allowing for greater flexibility and innovation in design and in construction. (emphasis supplied). Sen. Rep. at 6.

Similarly, the Report from the House Committee on Banking, Currency and Housing, 94th Cong. 1st Sess., No. 94-377, notes that performance standards provide:

> considerable flexibility to the designer of a building in determining how to meet the overall energy consumption limits and will tend to encourage innovations in design and materials. (emphasis supplied) House Rep. at 6.

Despite the clear congressional purpose, the proposed BEPS impose a set of constraints on the designer which virtually eliminate the choice of electricity for a given building. Thus, by severely restricting the designer's options in meeting the standards, DOE has failed to provide the performance standards Congress directed in ECPA.

E. The Proposed BEPS Unlawfully Regulate Energy Consumed By Lighting, Elevators, Exhaust Fans and Escalators In Commercial and Multi-family Buildings

In section 302(a)(1) of ECPA, Congress found that:

> large amounts of fuels and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings. (emphasis supplied).

It directed DOE to develop performance standards that would maximize the energy efficiency of those primary energy systems within the building. In addition to those systems, however, DOE has decided to regulate the energy consumed by lighting, exhaust fans, elevators and escalators in new commercial buildings.

DOE attempts to justify this departure from the letter of ECPA in the NOPR:

> The design energy requirements for commercial and multifamily residential buildings include energy for heating, cooling, ventilation, exhaust fans, artificial lighting, domestic hot water, and elevators and escalators . . . Other potential energy consuming systems or devices associated with the activities within a building are not necessary for maintaining comfort conditions for human occupancy. (emphasis supplied). NOPR at 2-8.

This distinction, however, was never explicitly or implicitly drawn by Congress in ECPA. Certainly it does not provide a statutory basis for deciding what energy use to regulate within the building perimeter.

Title III of ECPA neither refers to, nor authorizes consideration of, energy consumed by lighting -- or elevators, escalators and exhaust fans -- in new buildings. The legislative history of ECPA makes this quite clear. In the original bill, H.R. 8650, Congress defined the term "performance standard" to mean:

> a maximum energy consumption goal for a building to be met in connection with heating, cooling, ventilating, lighting and providing domestic hot water for the building . . . (emphasis supplied).

However, in H.R. 12169, which became ECPA, the reference to lighting was specifically omitted. The only rational inference is that Congress intended that DOE regulate no more than -- and certainly no less than -- the energy consumed in heating, cooling, ventilating, and providing hot water in new buildings.

F. Conclusion

For all of the above reasons, we believe that DOE has exceeded the basic grant of authority contained in ECPA. Thus, we strongly recommended that DOE reconsider its misguided course of action in this rulemaking in light of the foregoing discussion.

ADMINISTRATIVE LAW ISSUES

DOE HAS IGNORED PRINCIPLES OF ADMINISTRATIVE LAW THAT REQUIRE IT TO DISCLOSE CRUCIAL DATA TO THE PUBLIC DURING A RULEMAKING AND TO DEVELOP AN ACCURATE AND ADEQUATE RULEMAKING RECORD.

DOE has disregarded two fundamental precepts of administrative law to a significant and unacceptable degree in the BEPS rulemaking. First, DOE has ignored its obligation to disclose to the public for its scrutiny crucial data that will support the final rule. Specifically, DOE has not disclosed information, including research and analysis, crucial to a complete understanding of at least ten distinct aspects of the proposed BEPS, among which are weighting factors, life-cycle cost analysis of commercial and multi-family residential buildings, and the Standard Evaluation Technique. Second, DOE has ignored its duty to develop adequate and accurate supporting data on which to base the final rule. In particular, the research relating to energy use by new buildings, which was used as a basis for developing the Energy Budget Levels to be established by BEPS, is seriously deficient in both methodology and results.

These obligations, which are fundamental to the administrative rulemaking process, arise directly from the statutory requirements imposed on DOE by the Administrative Procedure Act ("APA") and the Department of Energy Organization Act ("DOE Act") to give interested parties prior notice of proposed rules and the opportunity to meaningfully comment on them. Section 4(b) of the APA, 5 U.S.C. §553(b), requires all agencies to give general notice to the public of all proposed rulemakings, and subparagraph (c) of that same section requires all agencies to "give interested persons an opportunity to participate in the rulemaking through submission of written data, views or arguments. . . ." In addition, section 10(e) of the APA, 5 U.S.C. §706, which establishes the standards for judicial review of rulemakings, specifies that courts must review "the whole record or those parts of it cited by a party." Thus, the public's participation in the rulemaking process, as well as the content of the rulemaking record have always been of prime importance. Since the passage of the APA, judicial decisions have clarified the specific obligations these provisions impose on agencies in connection with rulemakings.

II. BY FAILING TO DISCLOSE CRUCIAL FACTS, DATA, AND ASSUMPTIONS THAT WILL UNDERLIE THE FINAL RULE, DOE HAS PREVENTED MEANINGFUL PUBLIC PARTICIPATION IN THE RULEMAKING AND VIOLATED A FUNDAMENTAL PRINCIPLE OF ADMINISTRATIVE LAW.

In ten distinct areas relevant to the proposed rule, DOE has not disclosed crucial facts, data, and assumptions. Nevertheless, DOE intends to base the final rules for BEPS on the results of that undisclosed data, which is mainly ongoing research and analysis. Significantly, the ongoing research is in ten areas of critical importance to the rulemaking, not in minor, relatively unimportant areas where disclosure of the research could be considered unnecessary. The ten areas include (1) weighting factors; (2) single-family residential design energy requirements and the relative costs of saving electricity and fossil fuels in new buildings; (3) health effects from reduced air infiltration and ventilation; (4) life-cycle cost analysis of commercial and multi-family residential buildings; (5) the Standard Evaluation Technique; (6) mobile home standards; (7) solar and renewable resources; (8) building functions (restaurants); (9) climate; and (10) equivalency of BEPS to other building energy codes, such as ASHRAE 90-75 and the model Code. In addition, the Regulatory Analysis has not yet been completed.

The additional research will be crucial to an understanding of the rulemaking. In the area of weighting factors, for example, neither the preamble to the proposed rule, nor the technical support documents adequately explain

(1) how DOE derived the weighting factors; (2) how the mid-term price forecasts were aggregated into national averages; (3) how the PIFUA premiums have any applicability to BEPS; and (4) how the weighting factors were incorporated into the Energy Budget Levels, particularly for commercial and multi-family residential buildings. It is to be hoped that the additional research would shed light on these issues. Similarly, revisions are being made to the DOE-2 computer program, which is the centerpiece to the Standard Evaluation Technique and crucial to understanding the likely impact of BEPS. The public must have the opportunity to scrutinize these revisions prior to issuance of the final rule.

With respect to an agency's duty to disclose information so that the public can participate meaningfully in rulemakings, perhaps the most important court decision is Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375 (D.C. Cir. 1973), cert denied 417 U.S. 921 (1974). The leading authority on administrative law has characterized Portland Cement as "[a]n outstanding case which seems to enunciate a fundamental [principle of law]. . . ." 1 K. Davis, Administrative Law (2d Ed.) §6:26 (1978)(hereinafter, Davis). The case involved a rulemaking by the Environmental Protection Agency ("EPA") establishing performance standards for Portland Cement plants -- a rulemaking similar in many respects to the instant one. EPA published a proposed rule that disclosed some information about certain tests that EPA had performed, but at no time did EPA identify the location or methodology used in the tests.

Details of the tests were not disclosed to the public until after the final rules were published. In rejecting the final rules, the court held as follows:

> We find a critical defect in the decision-making process in arriving at the standard under review in the initial inability of petitioners to obtain -- in timely fashion -- the test results and procedures used on existing plants which formed a partial basis for the emission control level adopted, and in the subsequent seeming refusal of the agency to respond to what seems to be legitimate problems with the methodology of these tests.

476 F.2d at 392.

The court then went on to set forth the key principle:

> It is not consonant with the purpose of a rulemaking proceeding to promulgate rules on the basis of inadequate data or on data that, [in] critical degree, is known only to the agency.

Id. at 393. In many other cases, courts have similarly held that an agency must disclose information on which it relies to interested parties to a rulemaking. See e.g., National Crushed Stone Ass'n v. Environmental Protection Agency, 601 F.2d 111 (4th Cir. 1979); and United States v. Nova Scotia Food Products Corp., 568 F.2d 240 (2d Cir. 1977)

The provisions of the DOE Act, 42 U.S.C. §7101 et seq., specifically provide for even more disclosure than required by the literal language of the APA and are fully consonant with the principle of Portland Cement. In particular, §7191(b)(1) requires that all rules proposed by DOE "shall be accompanied by a statement of the research, analysis, and other available information in support of, the need for, and the probable effect of, any such proposed rule, regulation or order." These requirements are wide-ranging and intended to insure that the public is acquainted with virtually all of the background information underlying the proposed rule in question so that the public may make meaningfully comment. Once the notice and comment period has ended, §7191(d) allows DOE to issue a final rule only if it is "accompanied by an explanation responding to the major comments, criticisms, and alternatives offered during the comment period." The scheme called for by §7191 is clear. When proposing rules, DOE is to fully disclose its research and analysis so that interested persons can respond with meaningful comments that DOE must address when it issues the final rule. Through this scheme, Congress has sought to insure that DOE will have maximum input from the public -- and that this input will be considered by DOE -- in all of its rulemakings.

Given DOE's prior experience in the instant rulemaking in meeting deadlines it is unlikely that DOE will complete this massive research effort prior to promulgation of the final rule. DOE published the NOPR in late November 1979. It is now almost May 1980. The final rule is scheduled to be issued in the middle of August; yet, none of the additional research has been made available for public comment. Furthermore, even if the research is completed, it is inconceiveable that DOE will be able to fully disclose all the information in time for the public to carefully analyze it and submit meaningful comments on it to the agency. There can be no excuse for DOE's failure to disclose information upon which the final rule is to be based. Such a situation is at odds with the spirit of the APA, is contrary to judicial directives in Portland Cement, supra, and other cases, and is flatly prohibited by the express language of §7191(b)(1) of the DOE Act.

III. THE RULEMAKING RECORD DOE HAS COMPILED SO FAR LACKS THE ADEQUATE AND ACCURATE RESEARCH REQUIRED FOR DOE TO PROMULGATE A VALID FINAL RULE.

Not only has DOE failed to disclose data crucial to the final rule, but much of the data it has disclosed is either inadequate or inaccurate, or both. Specifically, the research relating to energy use by new buildings -- factual information highly significant to the overall development of BEPS -- is singularly deficient in quite a number of respects.

The research effort underlying BEPS began in 1976, after the passage of the authorizing legislation, and proceeded in three phases. Phase I provided information on the amount of energy new buildings (those built in 1975 and 1976) were being designed to use. This provided a baseline for further analysis and comparison with the data derived during Phase II. In this next phase, the research objective was to develop comparative data on energy consumption based on redesigns of some of the buildings studied in Phase I. Another research objective was the development of a format for the energy performance standards. Phase III consists of the additional research undertaken since Phase II to address many of the problems with BEPS that became apparent after the ANOPR was issued. The more serious deficiencies in DOE's research effort expose any final rule that may be promulgated to rejection by a reviewing court.

Pursuant to its responsibility under §706 of the APA to develop a rulemaking record for judicial review, DOE has an obligation to develop adequate and accurate supporting data on which to promulgate its final rules. According to the Supreme Court, "[judicial] review is to be based on the full administrative record that was before the Secretary at the time he made his decision." Citizens to Preserve Overton Park v. Volpe, 401 U.S. 402,420 (1971). "[T]he reviewing court must assure itself that the agency decision was based on a consideration of the relevant factors." Ethyl Corp. v. Environmental Protection Agency, 541 F.2d 1,34 (D.C. Cir. 1976). Indeed, rules can be found arbitrary and capricious because of inadequate or incorrect data in the rulemaking record. See, e.g., National Ass'n of Food Chains, Inc. v. Interstate Commerce Comm'n, 535 F.2d 1308, (D.C. Cir. 1976); Portland Cement, supra. See also, 1 Davis §6:13.

Where there are significant facts at issue, as there are in the BEPS rulemaking, the rulemaking record is especially important. Indeed, the factual ingredient of a rulemaking is often vital. 1 Davis §6:10. For example, in National Welfare Rights Org. v. Mathews, 533 F.2d 637 (D.C. Cir. 1976), the court, finding itself unable to evaluate the figures specified in the final rule, held the rule invalid, because it "consistently failed to articulate factual determinations underlying decisions by the Secretary." Id. at 649. The principles derived from these decisions are that the rulemaking record must be complete, it must reflect the agency's factual determinations, and it must be accurate. The research constituting the bulk of the BEPS rulemaking record, however, violates all of these principles. The specific deficiencies are discussed below:

A. The baseline data developed during the Phase I research are wholly insufficient to support a rulemaking of the magnitude of BEPS, because of deficiencies in the collection techniques.

The basis for the Phase I research, as well as all subsequent research leading to the formulation of BEPS was a survey of the designers of 3221 existing buildings, selected by researchers for DOE. The researchers conducted the building survey by sending questionnaires to the designers. Initially, we note that a definite bias was built into the 3221-building sample, because all the buildings selected were designed by independent engineer/architect teams. In spite of the fact that a substantial number of buildings are designed by in-house design teams of owners and developers, who may employ quite different design methodologies, no in-house teams were included in the survey.

Of the 3221 questionnaires sent out, only 1661 responses could ultimately be used for research purposes. While this constitutes a response rate of only 51.7%, there was no non-response follow-up, and no attempt was made to evaluate the energy consumption of the buildings for which no reponse was received. DOE's researchers recognized that the large non-response could have biased the survey results. Indeed, there was a specific recommendation that steps be taken in Phase II to measure any possible resulting bias. No such steps were ever taken, however. See Technical Support Document ("TSD") #2 at C-68.

The large non-response had serious, adverse effects on the research data. Essentially, it lowered the reliability of the sample data. For example, it reduced the average sample size for each combination of climatic zone and building type from 31 to 17. This, in turn, increased the variability of estimates on energy requirements from 10% to at least 20% (more in some instances). Moreover, the distributions of energy consumption by building types in the sample were far from normal, and the elaborate data analysis in the Climate Classification Analysis stated that "the distribution of [Building Energy Performance] at each [Standard Metropolitan Statistical Area] were non-normal with many extreme data." TSD#10 at 3.12. In addition, even the estimated construction volume based on the sample data was an average of 20% less than the actual volume for each building type. See TSD#2, App.B, Table 10.

It is also important to note that the 1661 responses that the researchers deemed "sufficiently complete for processing" were not necessarily completed by the responding designers. The questionnaires sought much information that was difficult for designers to retrieve, and the form itself was lengthy and complex, with "no clear definition of the data needed to answer certain questions." Phase One/Base Data, Final Report January 12, 1978 at 41-42. The designers completing the forms, even the most concerned, relegated the survey to a low priority. Id. at 41. Most of the 1661 "usable" forms were returned incomplete and had to be completed through follow-up investigation from field representatives -- primarily graduate students or teachers who did not necessarily have strong technical backgrounds. Finally, "almost every form required at least one additional long-distance telephone call from AIA/RC [the researchers for DOE] to confirm, add or correct data." Id. at 42. Despite these elaborate efforts, many problems, such as the definition and treatment of process energy, were never satisfactorily resolved.

In order to use many of the incomplete questionnaires, researchers also developed "default values" for indoor design conditions, building occupancy, and lighting for certain building types, which they applied liberally. Researchers also developed "supplemental design values" that were applied "where data could not be easily collected." Id. at 29. Thirteen supplemental design values were developed for data such as fuel heating values, system coefficients of performance, occupant heat gains, U-factors, and shading coefficients for each type of glass. The insertion of these two sets of assumed values in place of actual data from the responding designers seriously distorted the data on which the BEPS research was based. Even further distortion occurred when researchers disregarded the actual building operating profile for heating, cooling and lighting systems, and the actual occupancy characteristics in order to substitute "standard operating profiles." TSD#2 at A-53.

Overall, the large non-response, the lack of non-response follow-up and the insertion of a significant amount of assumed data serve to distort the results of the Phase I results and make the conclusions an unreliable basis on which to promulgate BEPS.

B. The reliability and validity of the Phase I research results were further eroded by the "comparability adjustments" made to the Phase I research results.

In Phase II, researchers selected 168 buildings from the 1661-building Phase I sample. These 168 buildings were to be redesigned to determine the maximum practicable improvements in energy efficiency that could be made. Obviously, the data derived from both Phase I and II had to be comparable in order to be useful. In several instances, such as energy consumption for hot water heating, vertical transportation, lighting and ventilation, the researchers deemed the results from Phase II superior to those from Phase I. The data from Phase I relating to hot water, for example, proved to be unusable for the researcher's purposes. In other instances, data was not comparable because of methodological changes adopted by the researchers in Phase II. For example, in Phase I, weather information was based on one typical day per month, but in Phase II the same information was based on all days per month.

In the areas mentioned, the researchers made "comparability adjustments" to the Phase I data based on the data obtained from the 168-building Phase II sample, In effect, the energy consumption of all 1661 buildings in Phase I was adjusted by the average energy consumption of only 168 buildings. Such a procedure is wholly unacceptable when the objective is to maintain the validity of the data. Moreover, the comparability adjustments were made without validating, in any way, the accuracy of the methodlogy used.

The statistical manipulations employed with respect to weather data are particularly troublesome. The Interim Report on Regional Assessment of Building Energy Performance concluded that heating and cooling degree days are the major vaiables in explaining energy requirements in new buildings. The report found the Phase II sample inadequate for use in developing fair and equitable standards for individual building types. DOE's researchers, however, ignored the cautions of this report, and they adjusted Phase I weather data on the basis of data developed from Phase II. Weather Adjustment Report, TSD#2, Appendix D. The researchers applied ratios of regression estimates, which besides being derived from unreliable regression equations, improperly adjust data on an average basis without considering variability of energy requirements. No confidence may be placed in the adequacy of these regression equations.

Still another defect in the comparability adjustments stems from basing the adjustments on the combination of as many building types as could be supported by results of analysis of variance ("ANOVA"). DOE's judgment that ANOVA is valid, despite the failure to test for homogeneity of variances among building types, is not acceptable. The relevant F- statistics do not meet minimally acceptable conditions. In particular, the class means are vastly different; the normal distributions of the population values are suspect; the populations do not have the same variances; and all the sample observations are not independent.

C. Serious deficiencies in the selection of the Phase II building sample and the statistical manipulations made during the Phase II research seriously weaken the validity of the reserch base underlying the proposed BEPS.

In addition to the defects in the research already noted, the Phase II research was deficient in a number of respects, as explained below.

First, the 168-building sample used as a basis for Phase II research did not constitute a representative sample of the 1661-building Phase I sample. On the contrary, the Phase II sample selection was significantly biased. The researchers automatically eliminated from selection (1) any building whose designer did not respond to the Phase I questionnaire; and (2) any building whose designer did not wish to participate. Further, there was a limit on the fee that would be paid any participant in the Phase II effort, and it is likely that this limit affected redesign efforts. While recognizing the problem with fees, DOE admits that it does not know and did not study the magnitude of this effect. Booze, Allen & Hamilton, Inc., Phase II Research Development Program Descriptions, June 9, 1979 at 1.15.

Second, many of the buildings included in Phase II were "created" by statistical means. In order to obtain buildings representing every building type in each climatic zone, the researchers made "adjustments . . . by statistical means to achieve [the desired number of buildings]." Id. at 1.11. Thus, for example, although the actual sample includes no hotels and motels in climate zones 2, 4 and 5, the Phase II research has developed data on such buildings.

Third, the researchers had to re-evaluate much of the Phase I data due to the use of a different computer program during Phase II and availability of more accurate data. The resulting "comparability adjustments" resulted in very large data differences.

Fourth, the Phase II sample included multi-family low-rise ("MFLR") buildings, but no such buildings were included in the Phase I sample. Moreover, the data from the MFLR buildings in Phase II were obtained in such a way that no confidence can be placed in them.

Fifth, in Phase II, the researchers eliminated or modified several of the building classifications that were used in Phase I. Offices and mercantile buildings, for example, were separated into large and small classifications, and stores and shopping centers, respectively. The category of colleges/ universities was eliminated altogether. Also, because the building types were not tightly defined, many buildings were not properly categorized, thereby confusing the data obtained.

Sixth, the computer programs used in conducting the research throws the research results into question, and the use of two different programs for Phase I and II research make comparisons of the research data from each Phase impossible without statistical adjustments. The AXCESS computer program is more limited in terms of heat loss and gain calculations than other computer modeling programs, and AXCESS does not have the capability to analyze many innovations in building designs such as intagrated daylighting, trombe walls, greenhouse effects, and movable window insulation. The long form program of AXCESS was used in Phase II, while the short form program was used in Phase I. The significant differences between the two programs obviated comparability and necessitated many of the statistical manipulations (adjustments) previously noted.

Seventh, the researchers used different occupancy profiles in Phase I and Phase II. The difference is signficiant because, as the researchers themselves admit, the "nature and reliability of the building classification system used for [BEPS] can be significantly affected by the use of standarized occupancy profiles and the procedures for handling them." Phase Two Task Report - Commercial and Multi-Family Residential Buildings at 165.

Finally, parametric adjustments were made to the Phase I research data that signficantly reduce confidence in the underlying data base. These parametric adjustments were intended to reflect improvements in energy designs in the Phase I sample that would have been made if all the buildings had been redesigned as in Phase II. Accurately projecting the results of 168 redesigns over 1661 buildings is difficult to accomplish with any degree of statistical confidence, because the variances involved and the adjustments necessary are just too great. Moreover, the number of redesigns in each building classification was too small to provide adequate basis for reasonable projections. Elaborate benchmark regression models resulted in lower R^2 values that even DOE would have preferred -- values that cannot be justified on statistical grounds. Nevertheless, DOE used these results in estimating energy budget levels by building type and locality.

D. There were serious flaws in the redesign process undertaken in Phase II.

Perhaps the most serious flaw in the redesign process was the researcher's failure to ensure that the redesigns were performed under as close to "real world" conditions as possible. To be sure, this was supposed to be the objective, and the researchers did require designers to work with client-imposed conditions to develop a more energy-efficient building. However, the actual conditions under which the redesigns took place were strictly atypical.

At least two years had elapsed since the original design, and there is no way to know that the designer even remembered all the client's original conditions. Coupled with the facts that AIA/RC was the real client for the redesign and that the original client was not on hand to evaluate the redesign, there can only be speculation on whether the original conditions were met. If AIA/RC approved, it was automatically assumed that the original client would have approved. The designer was also afforded assistence in his redesign effort. There were lectures, workshops, and technical discussions for the participating designers. Design teams met at two-day regional sessions to review each other's initial efforts, discuss problems, and offer suggestions. Private consultations were available with AIA/RC technical consultants throughout the redesign effort. Needless to say, similar aids are not normally available to designers in the "real world."

E. DOE failed to include in its computer modeling a significant amount of research data it obtained.

A number of redesign strategies -- involving innovative and solar approaches -- could not be modeled by AXCESS; therefore, they were not included in DOE's development of the proposed BEPS. These strategies generally involved passive solar designs, innovative HVAC system combination or controls, and natural lighting. Since these strategies were actually used in at least some redesigns, but were not modeled by AXCESS, the accuracy of the estimated building energy performance for these buildings is doubtful. The shortcomings of AXCESS in this regard not only indicate the inappropriateness of using AXCESS in developing BEPS, but also indicate that the budget levels proposed do not reflect the actual level of energy savings actually achieved through the redesign process.

F. More than one-third of the redesigned buildings could not have been actually constructed because they were in violation of building codes.

While the the inadequacies of AXCESS tend to result in lenient budget levels, the budget levels tend to be overly stringent because they are based on redesigns that legally could not have been implemented. It is estimated that 33.5% of the redesigns contained code violations. Battelle, Pacific Northwest Laboratories, Economic and Environmental Analysis of Building Energy Performance Standards, (October 31, 1978). In spite of the impossibility of implementing these redesigns, DOE nevertheless considered them in developing the proposed BEPS. Obviously, such a result cannot be justified.

Weighting Factors

The numbers derived for the economically based weighting factors and their subsequent application are very similar to the RUFS and RIFS approach suggested in the ANOPR. Irrespective of the revised methodology applied to derive them, the result is a perpetuation of many of the problems associated with RUFS and RIFS. DOE recognized some of these problems:

> "DOE decided to reject both the use of RUFS and RIFS and the use of weights that would effectively value all forms of energy equally at the building line (due to)... their inability to reflect the relative value to the nation of conserving different nonrenewable fuels..."[1]

A. The application of weighting factors results in gratuitous discrimination in favor of the natural gas and oil industries at the expense of the electrical industry.

The United States does not now, nor has it ever had a shortage of energy per se. However, it has experienced and will continue to experience serious shortages of certain types of energy, namely natural gas and oil, resulting in continuing and perhaps increased dependence upon foreign sources of supply to meet the excess of domestic natural gas and oil demand over domestic supply. It has been appropriate, therefore, to develop federal programs which are discriminatory to the extent that they discourage the use of natural gas and oil where suitable domestic alternatives are readily available. The Powerplant and Industrial Fuel Use Act of 1978 (PIFUA) is an example of such a program. DOE states that in the NOPR that "the choice of weighting factors will influence the mix of fuel types saved."[2] When designers specify use of either natural gas or oil instead of electricity, where choices are available, it will be easier for their designs to meet the design energy budget level. Conversely, when estimates indicate that a design energy budget will be exceeded, reduction in electrical usage will be targeted since each BTU of electricity eliminated from site use eliminates 2.79 Btu to 3.08 Btu from the design energy level. Of concern is the impact of this discrimination. In terms of national energy savings, irrespective of the fuels or other energy sources involved, the NOPR states, "the use of DOE's proposed weighting factors will not significantly affect the overall energy savings expected to be achieved by the Standards."[3] However, one must consider certain conditions which exist within the building industry relating to the types of fuels and other energy sources involved. Key among these conditions is the fact that virtually all buildings require electricity to a greater or lesser extent. In single-family residences, for example, electricity is required for lighting and motors.

Almost all single-family residential units with air conditioning use electric equipment due to its high efficiency. This is further evidenced, in the fact that DOE assumes that electric cooling equipment will be used in all single-family residences as shown in the design energy budget levels.

Electricity is used for the same purposes in multifamily residential and commercial buildings. The only exception is, electricity is required for even a wider range of uses. This would include; motors, such as those used for fans, pumps and vertical transportation.

In other words, because a designer must rely on electricity for a variety of purposes in most buildings, the application of the weighting factor creates a design penalty which is unavoidable. Discrimination against electricity in favor of natural gas and oil, by definition will only affect those building systems which an energy choice is available.

The two systems for which a fuel choice most often exists are space heating and domestic hot water. Together they comprise approximately 77 percent of all energy consumed in single-family residences.[4] They also comprise a significant amount of energy consumed in commercial and multifamily buildings. The presence of weighting factors will negatively affect the use of electricity for these systems.

In addition, and especially in the residential sector, the tagalong effect should be considered. The tagalong effect implies that the energy form used for space heating in a residence will also be the energy form used for domestic hot water, ovens and ranges, and possibly clothes dryers. Moreover, there is a distinct likelihood that discrimination against electricity will encourage revitalization of the long dormant natural gas cooling market.

The aspect of discrimination and the overall impact of it has been summed up in an Arthur D. Little, Inc., report to

DOE titled *An Impact Assessment of the Resource Utilization Factor Approach to Energy Conservation in New Construction*. Although the report was prepared to analyze the use of RUFS contained in ASHRAE 90-75 Section 12 and in the BEPS ANPR, the comments are still valid by virtue of the fact that the weighting factor of the NOPR is nearly identical in absolute value and in function. The report offers the following conclusions:

> "A source energy approach based on heat value of the basic fuels will save the gas industry from what it believes would be unfair competition from electric heat pumps. The ability allowed by site-based standards to avoid good energy savings techniques by substituting a heat pump could impair the gas utilities marketing efforts, primarily large commercial installations where the use of an engineer is justified. On the other hand, making a RUF approach mandatory, even for structures that would normally only employ good site-based conservation standards, could provide a potential bonanza for the gas industry. The electric heat pump could well be ruled out in most areas in spite of possibly favorable economics under current marketing conditions. Also, gas air conditioning in residential construction could have long last get a market foothold. This air conditioning load would be small at first, but would help partially offset the loss of industrial customers who would switch to cheaper fuels."[5]
>
> "A mandatory source energy approach will enhance the

opportunity for the gas utility to expand. Historically, builders have generally chosen gas systems rather than electric because of the high price for electricity. However, in those sections of the country where gas will prove to be the most source energy efficient, even those builders which might otherwise turn to electrically-heated homes will not be allowed to do so. If the gas utility does not have supplies to serve the customer, the builder would then install electricity or oil. At a minimum, however the gas utility has first refusal on these buildings..."[6]

B. Weighting factors as currently proposed are contrary to the Nation's energy policy.

Discrimination relative to fuel choices for purposes of implementing a national energy policy designed to husband the nation's resources clearly is in the national interest. For example, the Powerplant and Industrial Fuel Use Act of 1978 requires electrical utilities to virtually eliminate use of natural gas by 1990, prohibits these utilities from using more oil than was used in 1977, and even prohibits use of natural gas or oil for any newly constructed electrical utility generation facility. Obviously, the primary intent behind PIFUA is to discriminate against the use of natural gas and oil for certain specific uses that can be relatively easily satisfied by other fuels which are more domestically abundant, replenishable, or renewable. The Energy Tax Act of 1978 (ETA) works closely with PIFUA by providing a ten percent investment tax credit to electric utilities which purchase new boilers which use neither natural gas nor oil, and also provides tax incentives for the "early retirement" of natural gas or oil-fired boilers.

Approximately 3 Btu's of fuel are required to generate 1 Btu of electricity. As shown in Table 1, approximately 1/3 of the energy sources used to generate electricity are comprised of natural gas and oil. As such, on a national average basis, currently saving one Btu of electricity at the building boundary saves one Btu of natural gas or oil. Likewise saving one Btu of natural gas at the

TABLE 1:

NET ELECTRICITY PRODUCTION BY PRIMARY ENERGY SOURCE

		Coal	Petroleum	Natural Gas	Nuclear	Hydro
1976	TOTAL	46.3	15.7	14.5	9.4	13.9
1977	TOTAL	46.4	16.9	14.4	11.8	10.4
1978	TOTAL	44.2	16.5	13.8	12.5	12.7
1979	TOTAL	47.5	13.5	14.9	11.4	12.5

Source: Monthly Energy Review, Department of Energy, February, 1980 building boundary saves one Btu of natural gas or oil. Therefore discrimination against electricity in favor of natural gas and oil will not increase the supplies of these two valuable fuels to the nation.

Furthermore, the implementation of PIFUA implies clearly that the amount of natural gas and oil used to generate electricity in the future will decline both proportionately and in absolute terms. Table 2 comprises DOE's projections of the electrical energy fuel mix for the period 1985-1995. As can be seen, it is projected that the proportion of the overall national electrical generation fuel mix comprised by natural gas and oil is expected to decline from 28.4% in 1979 to 1.4% in 1995. In other words, it is projected by DOE that in 1985 every one Btu of electricity at a building boundary will have resulted in consumption of 0.042 Btu of natural gas/oil at the generating plant, on a national basis. This is assuming a 3 to 1 conversion factor as shown in Figure 1. Figure 2 demonstrates the impact of this electrical generation fuel mix shift using the hypothetical example of a home which requires one million Btu as measured at the building boundary.

Over the 15-year period 1980-95, the home will require 15 million Btus of natural gas or oil if either of these two fuels is delivered directly to the house. However, if electricity is used instead of natural gas or oil direccly, only 6.83 million Btus of natural gas or oil would be consumed. According to DOE's own projections, it would be of national interest to set weighting factors at 3 to 1 to discriminate in favor of electricity instead of against it.

TABLE 2:

U.S. ELECTRICITY FUEL USAGE, GENERATION AND SALES BY SECTOR: PROJECTION SERIES C, 1985-1995 (QUADRILLION BTU)

		Projections		
	1977	1985	1990	1995
Fuel Usage and Generation[a]				
Fossil Fuels				
Coal	10.27	15.44	22.05	28.44
Oil	4.03	4.47	3.17	0.58
Natural Gas	3.29	2.05	0.51	0.04
Subtotal	17.59	21.96	25.73	29.06
Nuclear	2.63	6.57	9.43	12.66
Hydroelectric	2.25	3.05	3.15	3.24
New Technologies	0.04	0.19	0.24	0.74
Total Fuel Usage	22.51	31.77	38.55	45.70
Efficiency Losses	15.26	21.35	25.88	30.53
Total Generation	7.25	10.42	12.67	15.17
Line Losses	0.59	1.01	1.21	1.48

[a] Source: Department of Energy

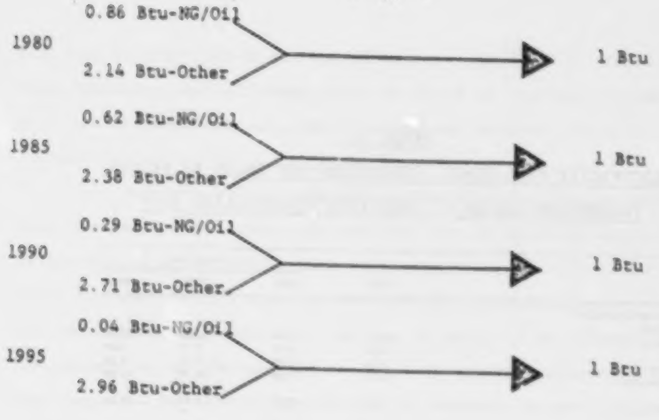

0.86 Btu-NG/Oil
1980
2.14 Btu-Other
1 Btu
0.62 Btu-NG/Oil
1985
2.38 Btu-Other
1 Btu
0.29 Btu-NG/Oil
1990
2.71 Btu-Other
1 Btu
0.04 Btu-NG/Oil
1995
2.96 Btu-Other
1 Btu

FIGURE 1: UTILITY FUEL MIX AND ASSUMED CONVERSION EFFICIENCY

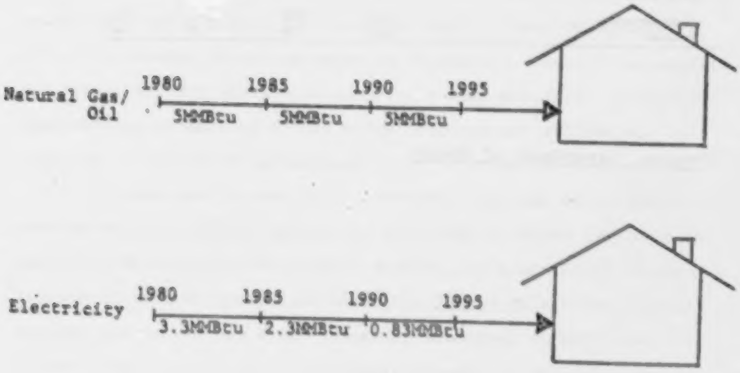

Natural Gas/ Oil
1980
1985
1990
1995
5MMBtu
5MMBtu
5MMBtu
Electricity
1980
1985
1990
1995
3.3MMBtu
2.3MMBtu
0.83MMBtu

FIGURE 2: CONSUMPTION OF CRITICAL FUEL RESOURCES

This conflict with obvious national priorities is drawn into even sharper focus when one considers the conversion efficiencies of natural gas, oil and electricity for space heating purposes in the house. When a central forced air, natural gas, or oil-fired space heating system is used, one Btu delivered to the building boundary delivers a maximum of 0.7 Btu in a given space due to the losses associated with the combustion process. When electricity is used to provide space heating, one Btu at the building boundary can deliver anywhere from 0.97 to 2.0 Btus (or more) in a given space, depending on the type of system employed. As shown in Figure 3, a total of 21.4 million Btus of either natural gas or oil would be needed to deliver a total of 15 million Btus to a conditioned space over the 15-year period 1980-1995, if either a natural-gas or oil-fired central forced air space heating system was used. In contrast, if electricity is used for space heating, the amount of natural gas and oil which would be consumed indirectly, on a national average basis, over the same period to provide the same amount of heat would be 7.04 million Btus for a central electric furnace, 6.83 million Btus for electric resistance baseboard, or 3.42 million Btus for an electric heat pump. If one assumes that the 1995 projected fuel mix remains constant for the remaining 15 years of the building life the following figures result for provision of one million Btus of space heating.

Type of Space Heating System	Amount of Natural Gas and/or Oil Consumed 1980-2010 to Deliver 1 MMBtu/yr to a Space
Natural Gas-fired Central Forced Air	42.8 MMBtu
Oil-fired Central Forced Air	42.8 MMBtu
Central Electric Furnace	7.7 MMBtu
Electric Resistance Baseboard	7.4 MMBtu
Electric Heat Pump	3.72 MMBtu

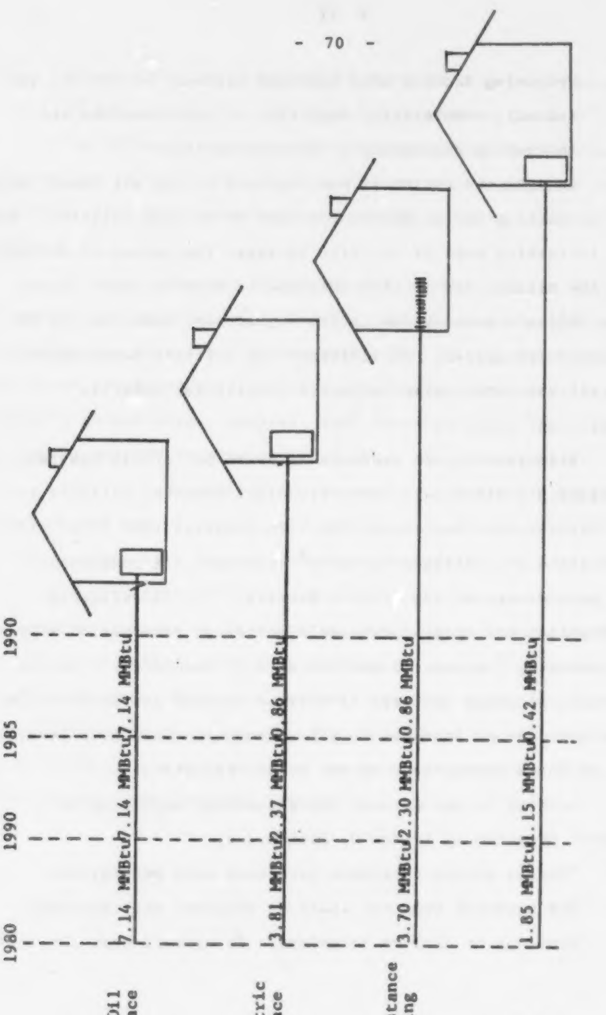

1980
1990
1985
1990
Gas/Oil Furnace
7.14 MMBtu
7.14 MMBtu
7.14 MMBtu
Electric Furnace
3.81 MMBtu
2.37 MMBtu
0.86 MMBtu
Resistance Heating
3.70 MMBtu
2.30 MMBtu
0.86 MMBtu
Heat Pump
1.85 MMBtu
1.15 MMBtu
0.42 MMBtu

FIGURE 3: AMOUNT OF NATURAL GAS AND/OR OIL CONSUMED TO DELIVER 1 MMBTU/YR TO A SPACE

C. Weighting factors will increase reliance on natural gas and oil, accelerating depletion of U.S. reserves and increasing dependency on foreign nations.

In 1980 the nation is meeting half of its oil needs through import, accounting for an exflow for some 90 billion dollars.[7] The rapidly increasing cost of oil will increase the amount of dollars leaving the nation, and it will continue to have profound impact upon the nation's economy due to its significant contribution to the inflationary spiral. In addition, the nation's dependence on foreign oil has substantial influence on national security concerns.

Historically, an increase in crude oil prices has resulted in increased oil discovery. However, since 1970 the nation's total proven reserves have been dwindling. In January, 1978 total proven reserves stood 29.5 billion barrels.[8] Domestic oil consumption in that year comprised 6.8 billion barrels.[9] It is estimated that the nation has total recoverable petroleum reserves of some 82 billion barrels,[10] enough to meet total U.S. demand for a period of 12 years, assuming that all 82 billion barrels are recoverable and that there is no increase in oil consumption over 1978 levels. Neither of these assumptions appear to be realistic.

Looking to the natural gas situation, according to a DOE report prepared by Arthur D. Little,Inc.:

> "Recent supply forecasts have been more pessimistic. Gas produced from the lower 48 (states) will probably continue to decline in volume. It appears that the

> country will be fortunate to maintain a constant level of gas supply over the next ten to fifteen years."[11]

The Arthur D. Little, Inc. forecast seems to be borne out by natural gas industry data which indicates that imports of liquified natural gas (LNG) have been increasing at an alarming rate, as shown in Table 3.

A study conducted by the Harvard Business School projected that natural gas supplies will last for another 25-30 years, providing that consumption does not increase above 1979 levels and that the price of gas increases sufficiently to encourage more conservation.[12] The study's author notes, however, that there is doubt that higher prices would sustain consumption much above the current rate.

Clearly, the application of weighting factors significantly accelerates the use of natural gas and to a lesser extent oil. This accelerated usage will deplete domestic reserves far more quickly than current forecasts indicate. For its part, the gas industry seems ready to respond to this challenge through increased importation. Plans to install pipelines from Canada and Mexico already are well under way. While the national security aspects of importation of fuel from these two nations are of less concern than those associated with fuel importation from noncontiguous foreign nations, clearly the economic concerns are similar.

TABLE 3:
LNG Import Data

Year	Million of ft^3	Trillion of Btu	% of Total Consumption
Before 1970	0	0	0
1970	757	.7721	.0035
1971	2,933	2.9916	.01
1972	2,262	2.3072	.01
1973	4,055	4.1361	.02
1974	0	0	0
1975	4,893	4.9909	.025
1976	10,155	10.3581	.05
1977	11,324	11.5504	.06
1978	84,422	86.1098	.43

Source: Gas Facts 1978 Data. American Gas Assn., Arlington, VA, 1978.

D. BEPS treats electricity as a fuel, therefore its implementation would establish defacto fuel use policies which are diametrically opposed to national energy use policy.

Policies inherent in PIFUA, ETA and other federal legislation demonstrate that it is national policy to reduce reliance on natural gas and oil. The need to pursue this policy is underscored by a recent report issued by the National Research Council of the National Academy of Sciences (CONAES):

> "The supply of fluid fuels -- gas and oil -- which together provide about 75 percent of the nation's energy, will be critical in the 198Qs and 1990s. Petroleum supplies world-wide will be severely and increasingly strained as oil production approaches its probable peak near the end of the century. This probably would be true even if there were no OPEC; the possibilities of politically controlled prices and production cutbacks are greatly enhanced by such a situation. Domestic production of oil and natural gas has already peaked and begun to decline, and U.S. demand for imports already imposes rather serious strains on the world in oil market. Oil production from Alaska will provide only temporary relief before beginning to fall off in the 1980s. Even the most optimistic projections of the CONAES Supply and Delivery Panel show irreversible declines in domestic oil and natural gas production in the future.

Coal and nuclear power are the only large scale alternatives to oil and gas in the near turn (before about 2000), as the use of fluid fuels begin to wane. Both are best suited to the generation of electricity in this period."[13]

The fact that electricity is an energy form which is manufactured (generated) from different energy sources, including but not being limited to fuels is completely ignored by BEPS which categorizes electricity as a fuel along with natural gas and oil.

Interestingly, Congress made the distinction in the very first line of the Energy Conservation Standards for New Buildings Act of 1976 which stated "large amounts of fuel and energy (emphasis added) are consumed unnecessarily each year..."[14] Recognition of the energy sources which are used to generate electricity is fundamentally essential if the act is to become implemented in a manner consistent with overall national energy policy. As already discussed, more than 2/3 of the nation's electricity is derived from fuels and other energy sources which are either replenishable, domestically abundant, or useable for nothing except generation of electricity.

Table 4 provides a state-by-state breakdown of utility fuel mixes. In Idaho, for example, 99.9 percent of all electricity is generated from hydro-sources. Because of this, any use of electricity in Idaho results in indirect use of a totally replenishable resource. If BEPS had been developed to encourage the use of electricity in such instances, it would then be consistent with

TABLE 4:

SOURCES OF ENERGY FOR ELECTRICAL GENERATION

1978

	COAL	OIL	GAS	HYDRO	NUCLEAR
NATIONAL AVERAGE	*42.9%*	*16.5%*	*13.8%*	*12.7%*	*12.5%*
Alabama	53.9%	-	-	11.4%	33.0%
Alaska	11.3	13.9	58.5	16.3	-
Arizona	48.9	10.4	17.0	23.7	-
Arkansas	8.5	45.5	2.8	13.7	29.5
California	-	43.9	21.6	26.9	5.5
Colorado	78.2	1.8	10.7	6.4	2.9
Connecticut	-	44.9	-	1.0	53.7
Delaware	29.2	68.6	2.2	-	-
Florida	17.1	49.9	15.5	-	17.2
Georgia	77.4	6.5	-	7.0	8.1
Hawaii	-	99.7	-	-	-
Idaho	-	-	-	99.9	-
Illinois	59.4	7.9	1.8	-	30.8
Indiana	95.7	3.2	-	-	-
Iowa	82.1	2.4	3.2	5.3	16.9
Kansas	50.4	10.1	39.4	-	-
Kentucky	93.8	-	-	5.7	-
Louisiana	-	28.3	71.7	-	-
Maine	-	11.8	-	23.0	65.2
Maryland	35.3	31.5	-	4.9	28.2
Massachusetts	-	83.8	-	-	15.4
Michigan	63.9	14.6	2.7	1.0	17.6
Minnesota	58.4	3.0	-	2.8	35.4
Mississippi	18.9	62.6	18.5	-	-
Missouri	90.4	2.7	4.6	-	-
Montana	28.8	-	-	70.2	-
Nebraska	30.7	4.2	6.5	7.8	50.8
Nevada	57.9	13.0	16.2	12.9	-
New Hampshire	40.3	39.7	-	20.0	-

TABLE 4 Continued

	COAL	OIL	GAS	HYDRO	NUCLEAR
NATIONAL AVERAGE	*42.9%*	*16.5%*	*13.8%*	*12.7%*	*12.5%*
New Jersey	18.2%	55.2%	-	-	26.9%
New Mexico	69.5	1.1	29.2	-	-
New York	12.3	45.6	-	22.8	19.2
North Carolina	74.2	1.5	-	8.7	15.7
North Dakota	76.2	-	-	23.5	-
Ohio	94.7	2.9	-	-	2.2
Oklahoma	8.2	-	87.1	4.3	-
Oregon	-	-	-	94.8	4.6
Pennsylvania	67.9	13.2	-	-	18.2
Rhode Island	-	99.3	-	-	-
South Carolina	36.3	9.3	1.1	7.5	45.9
South Dakota	29.6	-	-	69.3	-
Tennessee	81.1	4.0	-	14.9	-
Texas	17.8	2.2	79.6	-	-
Utah	83.9	1.0	6.5	8.5	-
Vermont	-	-	-	19.7	79.6
Virginia	25.4	37.1	-	3.1	34.2
Washington	6.3	-	-	89.5	4.2
West Virginia	98.0	1.3	-	-	-
Wisconsin	58.3	2.8	1.5	5.6	31.8
Wyoming	94.1	-	-	5.1	-
District of Columbia	-	100.0	-	-	-

Source: Edison Electric Institute

E. The use of average prices to develop weighting factors will create inequalities that do not fulfill the congressional purpose of attaining "the maximum practicable improvements in energy efficiency."

DOE recognized some of the problems inherent in the use of average prices for establishment of weighting factors. As stated in the NOPR:

> "The general approach starts with the market prices of various fuels, where a portion of their relative values is reflected. An important issue is whether to derive the factors using average prices or replacement cost. DOE believes that replacement costs are the most appropriate indicator of the cost to the nation of producing new sources of energy for new buildings, and that replacement costs are preferable to the development of weighting factors. However, since acceptable estimates of such costs were not available in time for this proposed rule average price forecasts were used to derive the proposed weighting factors."[15]

The use of national average prices to develop weighting factors obviate a significant regional and subregional price variation which exists. Insofar as electricity is concerned, averages vary substantially from state to state and from utility to utility within each state. (Table 5) Perhaps even more importantly prices can vary substantially from building-to-building connected to the same electric utility grid. For example, an article which appeared

Section 302(b)(2) of the act which states that the act's purpose, in part, is to "provide for the development and implementation, as soon as practicable, of performance standards for new residential and commercial buildings which are designed to achieve the maximum practical improvements and energy efficiency in increases in the use of nondepletable sources of energy." In BEPS, however, the use of electricity is discouraged by virtue of the 2.79 to 3.08 weighting factor which must be applied in the design process. In other words, in Idaho, BEPS would encourage the use of natural gas or oil instead of the replenishable resource, hydro.

TABLE 5:

AVERAGE REVENUE PER RESIDENTIAL KWHR SOLD 1976, 1977 and 1978

BY STATE -- TOTAL ELECTRIC UTILITY INDUSTRY

	Cents per Kilowatt-Hour		
	1976	1977	1978
Total United States	3.45	3.78	4.03
Maine	3.49	3.90	4.02
New Hampshire	4.36	4.82	5.47
Vermont	4.00	4.10	4.43
Massachusetts	4.97	5.28	5.33
Rhode Island	4.82	5.40	5.47
Connecticut	4.47	4.60	4.68
NEW ENGLAND	4.58	4.85	4.98
New York	5.37	5.88	6.06
New Jersey	5.27	5.85	5.98
Pennsylvania	4.12	4.48	4.67
MIDDLE ATLANTIC	4.86	5.31	5.49
Ohio	3.56	4.01	4.38
Indiana	3.02	3.42	3.85
Illinois	3.86	4.12	4.60
Michigan	3.89	4.21	4.56
Wisconsin	3.44	3.69	3.95
EAST NORTH CENTRAL	3.60	3.94	4.33
Minnesota	3.33	3.70	3.95
Iowa	3.61	4.01	4.15
Missouri	3.51	3.75	4.13
North Dakota	3.08	3.34	3.53
South Dakota	3.15	3.26	3.51
Nebraska	2.95	3.26	3.46
Kansas	3.18	3.76	4.04
WEST NORTH CENTRAL	3.35	3.70	3.96
Delaware	4.53	5.20	5.32
Maryland and D.C.	4.06	4.27	4.80
Virginia	3.31	4.06	4.25
West Virginia	3.39	3.49	3.64
North Carolina	3.29	3.58	3.84
South Carolina	3.31	3.65	3.79
Georgia	2.93	3.44	3.79
Florida	3.67	3.87	4.07
SOUTH ATLANTIC	3.48	3.80	4.05
Kentucky	2.62	2.90	3.23
Tennessee	2.30	2.35	2.74
Alabama	2.76	3.33	3.45
Mississippi	3.13	3.48	3.64
EAST SOUTH CENTRAL	2.60	2.87	3.14
Arkansas	3.39	3.81	3.97
Louisiana	2.67	2.88	3.04
Oklahoma	2.99	3.39	3.64
Texas	3.12	3.35	3.80
WEST SOUTH CENTRAL	3.04	3.43	3.65
Montana	2.23	2.38	2.62
Idaho	1.83	2.00	2.08
Wyoming	2.41	2.56	2.78
Colorado	3.26	3.44	3.62
New Mexico	3.35	4.00	4.69
Arizona	3.90	4.49	4.77
Utah	3.17	3.47	4.08
Nevada	2.84	3.23	3.41
MOUNTAIN	3.07	3.41	3.69
Washington	1.27	1.39	1.43
Oregon	1.86	2.21	2.41
California	3.54	3.97	4.20
PACIFIC	2.64	2.98	3.16
Alaska	3.43	3.92	4.20
Hawaii	4.77	5.36	5.86
ALASKA & HAWAII	4.29	4.73	5.21

Source: Edison Electric Institute

in February 17, 1980 edition of the Washington Post documented that two identical buildings located in Washington, D.C. had a per kilowatt-hour price disparity of more than 50 percent due to the different metering strategies employed (master metering vs. individual metering). An additional cause of this disparity, was the fact that within this particular utility's service area, (PEPCO) there are over 40 applicable rate schedules.[16]

In establishing its average price of electricity, DOE uses the national average cost to the customer. It is inappropriate to use the average/kwh charge which electric utility customers are billed. These charges reflect, among other non-energy related elements, an electric utility's substantial investment in anti-pollution equipment and costs associated with mandated and privately sponsored energy use management programs (i.e., RCS). These costs are not always included in the per-unit charges imposed by natural gas utilities or fuel oil suppliers. Pollution abatement costs are often not experienced by small users, but if they are, the costs are borne directly by the user. If the cost of antipollution measures are included in the electricity cost used for the purposes of weighting factors, the weighting factors will therefore be increased relative to other fuels, thereby penalizing electricity for improving the nation's air and water quality.

The use of weighting factors based on average prices will also create inequities in those areas where the actual price of the fuel is greater or less than the national average. In areas where the cost of an energy source specified for a building is greater than the national average, every Btu of energy saved would be worth more than the national average Btu.

Using an average cost for electricity used for space heating purposes is grossly inaccurate. It is well known that electricity costs vary from utility to utility, and within each utility, electricity costs vary in accordance with the season and in accordance with the daily load profile. The price of electricity when used as a heating power source is dependent on the capital requirements imposed on a particular utility to provide that service, as well as being a function of the cost of the particular fuels used and other operational considerations.

Using average costs can cause serious inaccuracies, as illustrated by the following example. Most of the electric utilities in the United States are summer peaking, the peak demand for electric power occurs in the summer and is often a loose function of ambient temperature. This summer peaking characteristic is due to the fact that the preponderance of air conditioning in the United States is electrically driven.

Obviously, the maximum capital requirements for a summer peaking utility occur in the summer, not in the winter, since the utility must build and maintain adequate generation, transmission and distribution facilities to meet the peak demand. Likewise the capital component imbedded in electric rates will generally be higher in the summer than in the winter, causing summer rates to be higher than winter rates.

Two examples are offered illustrating the point. Residential service rate schedules for the Commonwealth Edison Company in Chicago, Illinois[17] and the Potomac Electric Power Company in Washington, D.C.,[18] reveal that the additional per kwh cost for electric heat (i.e., the incremental rate for service in addition to basic usage of 500 kwh per month) is 2.225¢ and less than 2.5¢ respectively. By comparison, the cost per kwh for air conditioning is 5.919¢ and 3.78¢ respectively. This example does not take into account the complete cost of fuel (i.e., fuel adjustment charges) or taxes.

Electric utilities generally schedule generating units in accordance with economic dispatch. In other words, as a utility's power pool load grows, say on an hourly basis, the next cheapest generating source is called upon to serve the added load. Due to the high cost of oil, oil-fired units are often the last units to be put on line.

The cost of fuel used by a utility is eventually reflected in electric rates, usually via a fuel adjustment clause. A summer peaking company is often able to provide electric heating energy using a minimal amount of oil, resulting once again in a general trend towards lower winter or heating rates relative to summer rates. The residential customer of such a company will very likely find that the incremental electric rate for space heating is substantially lower than the incremental rate for air conditioning.

Even in the case of winter peaking electric utilities the situation must be examined carefully. For some winter peaking companies, the capital requirements for transmission, subtransmission and distribution facilities may still be determined by summer loads. This is so because the current carrying abilities of transformers, conductors, etc., are to some extent dependent on ambient temperature. Even the effect of space heating on generating capacity must bear close scrutiny, since some winter peaking companies may be able to take advantage of the excess capacity of their summer peaking neighbors, and since some electric heat systems (notably thermal storage systems) may not contribute fully (or even partially) to the electric system peak demand.

Interestingly, the cost based pricing methods employed by summer peaking electric utilities are also often used by natural gas utilities. Natural gas utilities generally experience their peak demand in the winter, hence gas prices in the winter may be higher than the average annual price. Yet average gas prices were used, a technique that may lead to an unjustifiably low gas weighting factor.

The net result of this explanation is to illustrate that the use of any "annual average" cost for electricity introduces substantial error into the weighting factor approach. Overall, for a summer peaking electric utility, the result of using "annual average" costs is to understate the annual fuel cost for air conditioning and to overstate the annual fuel cost for electric space heating. The true cost of electric power used for space heating should be taken on a company by company basis and it should be computed as the incremental cost in accordance with published rate schedules. Undoubtedly this is an extremely complex approach, but it is necessary to avoid serious errors developing weighting factors based on accurate costs.

F. The projections used for development of weighting factors are not reliable.

Weighting factors as previously stated were derived on the basis of national average prices. The average selected of those projected to exist in 1985. It is impossible to project future energy prices to any degree of accuracy. The future price of foreign oil is determined in the large measure by the unpredictable whims of a relatively small group of individuals, reacting to international situations as they deem appropriate.

The future price of domestic oil is subject to substantial change by October of 1981, when domestic prices will be decontrolled[19] to permit them to rise to world oil prices. World oil prices are determined in large measure by those who set foreign oil prices. The future of domestic natural gas is uncertain due to deregulation which, for new natural gas, will take effect on January 1, 1985.[20] The price in large measure will then be effected by supply and demand. If BEPS are promulgated in their present form there will be an immediate increase demand for natural gas. The demand impact at this time has not been determined. Contrary to this, the future price of electricity can be projected with a certain degree of certitude, but the plans of many electrical utilities have been changed substantially due to problems associated with nuclear development. Evolving legislation relative to environmental protection also is a concern, as is the price of coal which may rise sharply due to increased demand for a synthetic fuels program. The same uncertainties which can be forecast for the future have existed in the past, in April 1979 DOE projected the price of a home heating oil in 1980 to be \$25.6/barrel in 1980 dollars.[21] Revised forecasts issued by DOE in January 1980 project the 1980 prices to be \$37.8[22] an increase of 48% in nine months.

Whether or not the projections are accurate the fact is that it will be equally difficult to establish projections using replacement costs, the method which the NOPR states is preferred to average costs. As an example, the replacement cost of electricity is uncertain due to the nation's attitude toward nuclear powered generation. Also, while less reliance on oil and natural gas for electric generation is likely, environmental restrictions on the use of coal may make it impractical to rely on anything but natural gas and oil, particularly if the nuclear option is foreclosed. In short, basing weighting factors on projected replacement costs is even more inexact than basing them on projected average cost.

G. Weighting factors do not account for the value which the nation places on conserving different fuels.

According to the NOPR, "...DOE has developed an approach using weighting factors that explicitly account for the cost of fuels and the value to the nation of conserving different fuels."[23] Simply stated, the NOPR statement is not true. If national values are to be set at all, the energy sources in question should be treated as substances as opposed to energy sources. It is only through this approach that one can obtain the overall scope of vision which is required. For example, one cannot consider oil solely in terms of its value as a building heating energy source. One must consider its value as a transportation energy source as well as a fundamental feedstock of the nation's petrochemical industry. In other words, it is necessary to evaluate all the many different needs which the nation has and is projected to have for a given substance, then rank the needs involved, and to evaluate the degree to which other substances can be met to satisfy the same need.

Because DOE is not pursuing this method, it has created what is tantamount to a penalty factor affecting any and all sources used for generating electricity and has ignored the benefits that can accrue if electricity is allowed to substitute for scarcer fuels as free market economics dictate. In the case of geothermal, hydro nuclear, wind, and solar-electric technologies, it must be recognized that the only practical usage is to generate electricity. It can even be argued that coal's best use lies in generating electricity. To in any way discourage the use of these energy sources is to reduce the value of these energy sources to the nation.

The national value aspect of energy source selection is extremely important and complex. DOE has elected to treat it in a simplistic manner by considering electricity to be a fuel. Simplistic measures cannot be accepted in a program of this magnitude.

H. Weighting factors as presently construed will discourage more efficient use of existing electrical utility capacity and will increase consumer cost.

The Public Utility Regulatory Policy Act of 1978 (PURPA) contains a variety of provisions whose implementation is intended to increase the efficient use of electric utility facilities.

The electric utility industry expresses efficiencies in terms of load factor, which is the relationship between average demand load and peak demand load. Generally, the higher the load factor, the more electric utilities can make use of their generating capacity, and the more effectively they can operate. Electric utilities are concerned about load factors and accordingly are concerned about peak demand. In essence they must construct new facilities in order to meet the peak demand, despite the fact that average demand may be lower than the peak. If a load factor is high the utility will be able to spread its fixed costs over larger energy deliveries, resulting in a lower cost per kilowatt-hour to the ultimate customer.

In most areas of the country, an electric utility's peak demand is experienced during summer months due to the preponderance of electric air conditioning equipment. As such, most of the nation's electrical utilities have excess capacity during winter months. The relationship between summer and winter peak loads in the various regions of the country are shown in Table 6. The summer peak load in each case is expressed as a percentage of the winter peak load with a following season with December representing winter for years 1971-79. BEPS discourages the use of electricity for space and water

TABLE 6:

SUMMER PEAK LOADS EXPRESSED AS PERCENTAGE OF PEAK LOAD FOR THE FOLLOWING WINTER

	ACTUAL							
REGIONS	71	72	73/74	74/75	75/76	76/77	77/78	78/79
NPCC	[illegible]	[illegible]	111	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MAAC	[illegible]	[illegible]	[illegible]	[illegible]	114	[illegible]	[illegible]	111
ECAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SERC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MAIN	[illegible]	[illegible]	[illegible]	[illegible]	118	[illegible]	[illegible]	[illegible]
SPP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ERCOT	[illegible]	[illegible]	[illegible]	[illegible]	131	[illegible]	[illegible]	134
MARCA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSCC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL ELECTRIC UTILITY INDUSTRY OF THE CONTIGUOUS U.S.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: 1979 Annual Electric Power Survey, Edison Electric Institute, April 1979 heating and tagalong loads. At the same time however the use of electricity for air conditioning will be encouraged. As a result, utility's summer peaks will increase without any corresponding increase in winter loads. This will worsen load factors, thus resulting in each kilowatt-hour sold having to be responsible for larger share of the utility's fixed investment, resulting in higher rates for consumers.

It seems obvious, that if BEPS were to be in concert with the goals of the other national energy policies the use of electricity for space heating would be encouraged in the vast majority of areas in the nation where there is excess coal, nuclear or hydro capacity during winter, since the heating load could be met without causing utilities to expand generating capacity.

I. The inclusion of weighting factors will cause the price of oil and natural gas to increase for new and existing users.

Weighting factors of 2.79 and 3.08, penalize designers for using electricity and encourage them to use natural gas and oil whenever possible. This will affect an upward shift in the demand for oil and natural gas. Associated with the upward shift will be increased prices for both new and existing users of natural gas and oil.

In the past, the supply of oil and natural gas came from domestic sources. As the demand for oil and gas increased, domestic sources could not keep up, therefore imported sources had to be tapped to fulfill the increase in demand. Domestic supplies of natural gas and oil are not adequate to meet existing domestic requirements, therefore any additional demands will be fulfilled by imported supplies.

As the requirement for oil and natural gas increase because of BEPS, the market will be forced out of equilibrium in that the demand will exceed the supply at the current market price.

The market will inherently strive to reach a point of equilibrium. This can be completed in one of two ways: a shift in the demand (upward), or a shift in the supply (downward). Any new requirements will be supplied by imported fuels; domestic oil and natural gas resources cannot influence the supply. This only leaves one option; a shift in the demand upwards to reach equilibrium.

As the demand shift upwards, the associated price will increase as a function of the price of imported fuel supplies. This increase can be substantial depending on the international fuel price environment. As a result all users of natural gas and oil will be forced to pay higher prices for these fuels.

References

1. Notice of Proposed Rulemaking, Energy Performance Standards for New Buildings, November, 1979, pp. 2.33-2.37.
2. Id, p. 2.37.
3. Id, p. 2.41.
4. Midwest Research Institute, Energy Efficiency Program for Appliances, February, 1977.
5. Arthur D. Little, Inc., An Impact Assessment of the Resource Utilization Factor Approach to Energy Conservation in New Construction, July, 1979, pp. 81-82.
6. Id, p. 73.
7. Executive Office of the President of the United States, Special Analysis, Budget of the United States Government, Fiscal Year 1981, p. 383.
8. Energy Information Administration, Annual Report to Congress 1978, Volume Two, Table 15, p. 33.
9. Id, Table 3, p. 7.
10. Id, Table 10, p. 23.
11. Arthur D. Little, Inc., Note 5, p. 69.
12. Stobaugh, Robert and Yergin, Daniel, Energy Future, p. 58.
13. National Academy of Sciences, Energy and Transition, 1985-2010, March, 1980, p. 18.
14. Pub. L. 385, Title III, Section 302(a)(1).
15. Notice of Proposed Rulemaking, Note 1, p. 2.36.
16. Potomac Electric Power Company, Rate Schedules for Service in Washington, D.C., Maryland and Virginia.
17. Commonwealth Edison Company, Electricity for Cities and Towns in Service Area.
18. PEPCO, Note 16.
19. Executive Office of the President, Special Analysis, Budget of the United States Government, p. 386.
20. Ibid.

21. Federal Register, Volume 44, No. 84, April 30, 1979, p. 25381.

22. Id, Volume 45, No. 16, January 23, 1980, p. 5640.

23. Notice of Proposed Rulemaking, Note 1, p. 2.36.

Commercial Energy Budget Level Selection

Energy budget levels for the commercial and multifamily residential sector were developed through a decision-making process which resulted in selection of one of three levels for a given building classification: the R_{30} or "strict level" (energy performance attained by 30% of the redesigns); the R_{50} or "nominal level" (attained by 50% of the redesigns); and R_{70} or "lenient level" (attained by 70% of the redesigns). As a result of the numerous problems associated with the basic research, statistical manipulations, etc., the energy budget levels for commercial and multifamily residential buildings are, for the most part, unrealistic and possibly unattainable. The uncertainty of the statistical manipulations performed, and the questionable assumptions and procedures used together seriously devalue the confidence that could be placed on the validity of the energy budget levels. Energy budget levels for the single family residential structures were developed through application of a life cycle costing technique which is commented upon in the live cycle costing section of this analysis.

A. The design energy budget levels (DEB's) for commercial and multifamily buildings are unrealistically low. They cannot be attained by most designers and therefore impose an economic burden on owners, through increased design costs and increased construction costs.

The design energy budget levels for commercial and multifamily residential buildings were based primarily on statistical calculations tempered with alleged expert judgments. Based on these statistical evaluations made by persons whose familiarity with construction is unknown, DOE selected the strict R_{30} level for both small and large office buildings. It is significant to note that DOE did consult with government construction experts. These experts were opposed to the R_{30} level:

> "DOE sought advice from federal officials experienced in the design of energy conserving federal buildings. The 50th percentile design levels were presented for review by these building experts from the Army Corps of Engineers, National Aeronautics and Space Administration, National Bureau of Standards, Department of Defense, Veterans Administration, Department of Housing and Urban Development and Department of Health, Education and Welfare. These experts were asked if, based on their experience, they could expect to construct buildings which could meet those or more stringent "Energy Budget" levels. The consensus of these experts was that the 50th percentile level could be met, although at a possible undesirable increase in first cost and design time. They felt that these were the most stringent levels the industry was capable of meeting."[1]

DOE also conducted life-cycle cost analysis of office buildings to determine energy budget levels. They found that levels even below R_{30} could be economically justified. But attainment of even lower budget levels assumed possession of knowledge not now possessed by designers:

> "The second analysis was a life-cycle cost analysis of office buildings, the result of which are described in the proposed rule. The major finding was that life-cycle cost-effective design solutions were achievable that were significantly below the strict levels (30th percentile) and analyzed above. The implication is that energy conservation at very low energy budget levels is cost-effective for office buildings. To reach this energy budget level, it was necessary to spend considerable design input time by the building designers and by energy consultants and to conduct extensive computer analyses to identify the conservation strategies that result in low design energy requirements. In fact, the designers did not identify all possible cost-effective conservation strategies. Therefore, DOE feels that conclusions drawn from the analysis must be tempered by the necessity for significant energy conservation knowledge not presently possessed by many designers."[2]

The design energy budgets for large office buildings range from 101.0 to 140.0 MBtu/ft.^{2}/yr., depending on the climatic conditions in a particular area. For small office buildings this range is from 87.0 to 125.0 MBtu/ft.^{2}/yr. However, data developed in other studies indicate that these levels are not likely to be obtained easily. Results of several studies indicate that for existing office buildings the actual energy consumption is significantly higher than would be permitted under BEPS. (See Tables 7 and 8). Further, the experience of the General Services Administration (GSA) with an innovative office building in Manchester, New Hampshire, clearly indicates the unreasonableness of attaining design energy budgets required by BEPS. GSA retained some of the nation's most prominent energy conservation consultants for the project. The building was designed to meet a 55 MBtu/ft.^{2}/yr. design energy budget. Based upon actual performance this goal has yet to be achieved. The energy budget levels for most other types of buildings are also extremely low and may not be realistically attained. In the attached Tables (9-18) energy consumption levels for a variety of "energy conserving" buildings that are covered by BEPS are substantially in excess of those indicated by the BEPS energy budget levels. It must be recognized that weighted energy consumption levels for these buildings would be as much as 50% higher than the values listed.

TABLE 7:

OFFICE BUILDING ENERGY BUDGETS	
BUILDING TYPE	**Btu/ft²/yr**
High-rise Office Buildings	
Low energy user	72,000
Average energy user	210,000
High energy user	403,000
Federal Office Buildings	
Low energy user	77,000
Average energy user	210,000
High energy user	1,056,000
General Office Buildings	
Low energy user	83,000
Average energy user	102,000
High energy user	140,000
Office Buildings with Computers	
Low energy user	119,000
Average energy user	180,000
High energy user	333,000

Source: ASHRAE JOURNAL
January 1980

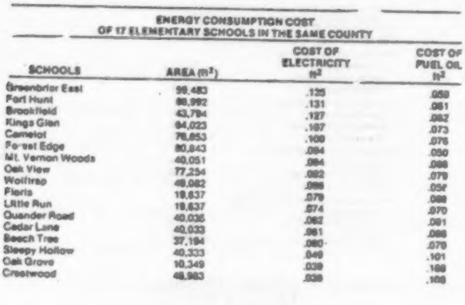
TABLE 8:

OFFICE BUILDINGS
OWNER-OCCUPIED
PHILADELPHIA

GROSS AREA	Btu/ft²/yr
400.000	209.000
600.000	218.000
900.000	222.000
900.000	140.000

Source: ASHRAE JOURNAL
January 1980

TABLE 9

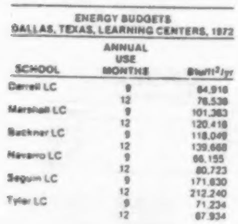


ENERGY CONSUMPTION COST
OF 17 ELEMENTARY SCHOOLS IN THE SAME COUNTY

SCHOOLS	AREA (ft²)	COST OF ELECTRICITY ft²	COST OF FUEL OIL ft²
Greenbriar East	99,483	.135	.059
Fort Hunt	88,992	.131	.061
Brookfield	43,794	.127	.082
Kings Glen	64,023	.107	.073
Camelot	78,853	.100	.076
Forest Edge	80,843	.094	.050
Mt. Vernon Woods	40,051	.094	.088
Oak View	77,254	.092	.079
Wolftrap	48,082	.088	.052
Floris	19,637	.079	.088
Little Run	19,637	.074	.070
Quander Road	40,036	.062	.081
Cedar Lane	40,033	.061	.088
Beech Tree	37,194	.080	.079
Sleepy Hollow	40,333	.049	.101
Oak Grove	10,349	.039	.169
Crestwood	48,983	.038	.109

Source: ASHRAE JOURNAL, January 1980

TABLE 10

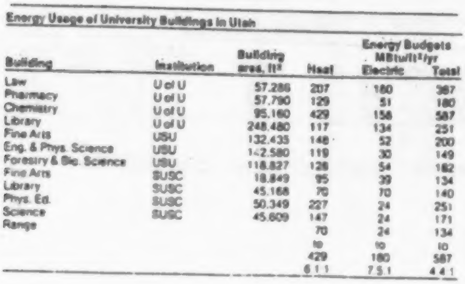


ENERGY BUDGETS
DALLAS, TEXAS, LEARNING CENTERS, 1972

SCHOOL	ANNUAL USE MONTHS	Btu/ft²/yr
Darrell LC	9	84,916
	12	78,538
Marshall LC	9	101,383
	12	120,418
Buckner LC	9	118,049
	12	139,668
Navarro LC	9	66,155
	12	80,723
Seguin LC	9	171,630
	12	212,240
Tyler LC	9	71,234
	12	87,934

Source: ASHRAE JOURNAL, January 1980

TABLE 11:

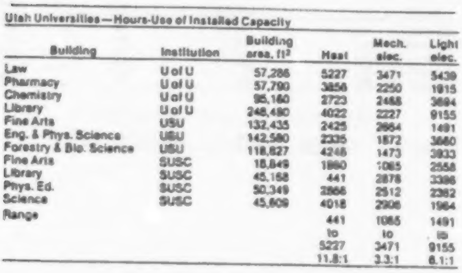


Energy Usage of University Buildings in Utah

Building	Institution	Building area, ft²	Heat	Energy Budgets MBtu/ft²/yr Electric	Total
Law	U of U	57.286	207	180	387
Pharmacy	U of U	57.790	129	51	180
Chemistry	U of U	95.160	429	158	587
Library	U of U	248.480	117	134	251
Fine Arts	USU	132.435	148	52	200
Eng. & Phys. Science	USU	142.580	119	30	149
Forestry & Bio. Science	USU	118.827	128	54	182
Fine Arts	SUSC	18.849	95	39	134
Library	SUSC	45.168	70	70	140
Phys. Ed.	SUSC	50.349	227	24	251
Science	SUSC	45.609	147	24	171
Range			70	24	134
			to	to	to
			429	180	587
			6.1:1	7.5:1	4.4:1

Source: ASHRAE JOURNAL, January 1980

TABLE 12:



Utah Universities—Hours-Use of Installed Capacity

Building	Institution	Building area, ft²	Heat	Mech. elec.	Light elec.
Law	U of U	57,286	5227	3471	5439
Pharmacy	U of U	57,790	3856	2250	1915
Chemistry	U of U	95,160	2723	2488	3694
Library	U of U	248,480	4022	2227	9155
Fine Arts	USU	132,435	2425	2664	1491
Eng. & Phys. Science	USU	142,580	2335	1872	3660
Forestry & Bio. Science	USU	118,827	4246	1473	3933
Fine Arts	SUSC	18,849	1860	1085	2558
Library	SUSC	45,168	441	2878	3386
Phys. Ed.	SUSC	50,349	2866	2512	2382
Science	SUSC	45,609	4018	2906	1964
Range			441	1085	1491
			to	to	to
			5227	3471	9155
			11.8:1	3.3:1	6.1:1

Source: ASHRAE JOURNAL, January 1980

TABLE 13:

COLLEGE AND UNIVERSITY
OVERALL ENERGY USE

TYPE (NUMBER)		MBtu/ft^2/yr		
		AVERAGE	LOW	HIGH
Two-Year	(42)	212	56	771
Four-Year	(81)	139	33	273
With Graduate	(166)	190	31	519
With Medical	(56)	261	43	1027

Source: ASHRAE JOURNAL, January 1980

TABLE 14:

COLLEGE AND UNIVERSITY
BUILDING TYPE ENERGY USE

TYPE (NUMBER)		MBtu/ft^2/yr		
		AVERAGE	LOW	HIGH
Dormitory	(90)	123	16	387
Classroom	(83)	136	34	581
Library	(88)	143	31	409
Hospital	(37)	224	38	531
Laboratory	(63)	257	29	1079

Source: ASHRAE JOURNAL, January 1980

TABLE 15:

APARTMENT HOUSE ENERGY BUDGETS

HEATING AND COOLING SYSTEM	NO. BLDGS.	APTS.	Btu/ft²/yr
Elec Ceiling + Central	4	415	66,000
Elec Base + Wall	22	3726	70,000
Elec Ceiling + Wall	3	275	77,000
Elec Wall Heat + Cool	5	990	78,000
Gas Furnace + Elec Cool	3	330	139,000
Boiler Fan Coil + Central	8	1324	141,000
Steam + Wall	6	1883	145,000
Steam Fan Coil + Absorption	7	2856	203,000
Boiler + Window	14	6755	204,000
Boiler Fan Coil + Absorption	4	1344	210,000

Source: ASHRAE JOURNAL, January 1980

TABLE 16:

FOOD SERVICE BUILDING ENERGY USE

TYPE (NUMBER)		AVERAGE ft²	AVERAGE MBtu/ft²/yr
Sit Down	(44)	6,299	1,067
Cafeteria	(21)	10,751	1,131
Coffee Shop	(18)	3,621	1,835
Fast Food	(20)	2,257	1,882

Source: ASHRAE JOURNAL, January 1980

TABLE 17:

ENERGY USAGE OF THREE VA HOSPITALS	
HOSPITAL	Btu/ft²/yr
Lake City, Fla	
Fuel	189,000
Electricity	73,000
Total	262,000
San Diego, Cal.	
Fuel	285,000
Electricity	122,000
Total	407,000
Buffalo, N.Y.	
Fuel	176,000
Electricity	41,000
Total	217,000

ASHRAE JOURNAL January 1980

Source: ASHRAE JOURNAL, January, 1980

TABLE 18:

CHICAGO HOSPITAL ENERGY USE
1976 DATA

SIZE-BEDS (NUMBER		MBtu/ft²/yr		
		AVERAGE	LOW	HIGH
Under 200	(12)	333	232	543
200-299	(18)	397	108	780
300-499	(22)	380	234	738
Over 500	(14)	280	184	382
Overall	(64)	350	108	780

Source: ASHRAE JOURNAL, January 1980

B. The design energy budget levels selected for commercial and multifamily residential buildings discriminate against electricity.

The design energy budget levels virtually eliminate all electric buildings and therefore would encourage the use of natural gas and oil for space heating purposes. An example that indicates this is a small office building in the Washington, D.C. area. With an assumed lighting level of 2 watts per square foot (a modest lighting level), only 13.9 Mbtu/ft.^{2}/yr. remains for space heating, cooling, water heating and all fans, motors, pumps, elevators, etc.

Example

Small office-50,000 ft.^{2}

Location-Washington, D.C.

Lighting level-2watts/ft.^{2}

Operating Profile-No. 43 from Technical Support Document #5

Total design energy budget = 104,000 Btu/ft.^{2}/yr.

Total design energy consumption for an all electric building = 104,000 ÷ 3.08 = 33,766

Total lighting load = 100,000 watts or 100 Kw

Energy requirements weekdays = 1040 kWh/day x 260 days = 270,400 kWh

Energy requirements - Saturday = 280 kWh/day x 52 days = 14,560 kWh

Energy requirements - Sunday = 120 kWh/day x 52 days = 6,360 kWh

Total annual energy requirements for lighting = 19,886 Btu/ft.^{2}/yr.

Remainder of design energy budget available for domestic hot water, exhaust fans, heating and cooling, etc = 13,880 Btu/ft./yr.

Note that only 41% of the budget can be used for all other non-lighting tasks. Because the basic components (i.e., air conditioning, fan motors, pump motors, elevators, etc.) will probably be electric and can only be reduced so far, the amount of energy available for heat will be very low. Because the weighting factor of approximately three is applied to the electric portion (lights, elevators, air conditioning), it will be much easier for a designer to meet the budget by using oil or gas wherever possible, particularly for space and water heating.

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C. Design energy budget levels affect lighting in such a manner that productivity will be threatened; additional energy consumption may also result.

Research by government, colleges and universities, manufacturers and various associations over the last 25 years indicate there is a definite link between lighting and productivity. In fact, maximum productivity cannot be obtained unless the lighting provided is optimal for the task and the individual needs of the workers. Because electricity is the only form of energy which can reasonably be used for lighting, and because electrical energy in commercial buildings must contend with the weighting factor of 3.08 and it is easier to reduce lighting energy consumption than energy consumed by motors, it is appropriate to assume that lighting will be kept at minimal levels.

When lighting is kept at minimal levels, the light required for optimal task performance may not be available. When that occurs it takes more time to perform tasks; more errors are made and even more time is required to correct them. This is demonstrated clearly in many various studies,[3] such as a recent one whose results are shown in Table 19. It should be recognized that lost time and money are not the only concerns. Generally speaking, lost productivity must be made up either by more people or the same number of people working longer hours. In either case, more energy must be consumed to meet the environmental requirements of the people. DOE has clearly not addressed the relationship between lighting and productivity. This issue should be addressed before the final rulemaking.

TABLE 19:

—Productivity of Insurance workers—Cost Analysis Based on Time Required to Perform Insurance Task

Fc[*]	Relative time[1] for same work		Labor cost[2] for same work ($/ft²/yr)	Total cost[3] of light ($/ft²/yr)	Total cost[4] ($/ft²/yr)	Net annual dollar savings[5] ($/ft²/yr)	Savings per ten workers
50	1.000	Typist	$73.50		$73.85	0	0
		Checker	$75.00		$75.35		
		Underwriter	$136.85		$136.85		
		Total	$284.35	$0.35	$286.05		
100	0.972	Typist	$71.44		$72.14	$1.71	$1,710.00
		Checker	$72.90		$73.60	$1.75	$1,750.00
		Underwriter	$133.02		$133.72	$3.13	$3,130.00
		Total	$276.36	$0.70	$279.46	$6.59	$6,590.00
150	0.919	Typist	$67.55		$68.60	$5.25	$5,250.00
		Checker	$68.92		$69.97	$5.38	$5,380.00
		Underwriter	$125.76		$126.81	$10.04	$10,040.00
		Total	$262.23	$1.05	$265.38	$20.67	$20,670.00

[*] Lighting conditions for the test provided an LEF of 1.0. Thus, fc and ESI are equivalent.

[1] *Time* is based on the productivity increases of 2.8 percent at 100 fc and 8.1 percent at 150 fc with 50 fc being the base.

[2] *Costs* are based on approximate 1976 salaries for the Connecticut General Life Insurance Co. and do not reflect fringe benefits. One hundred ft² of office space is taken as the average space per worker.

[3] 1976 amortized initial cost plus operating cost at 3¢/kWh.

[4] *Total cost* equals Labor cost minus Cost of light, i.e., for typist at 50 fc, $73.50 − $0.35 = $73.85.

[5] *Net savings* equals the difference between the appropriate total cost figure, i.e., for typist at 100 fc, $73.85 − $72.14 = $1.71.

Source: Lighting Design & Application, February 1980

In addition, lighting should be considered process energy. Lighting is necessary to accomplish work, just as electricity is needed for typewriters, copiers, and other tools of office production. Accordingly, it would be appropriate to consider at least a portion of lighting used for service purposes, and for retail sale purposes, as "process energy" which should not be included in design energy budgets. It should also be recognized that lighting was never mentioned in ECPA.

D. Proposed energy budget levels for commercial buildings reduce flexibility in building design.

As presently constructed design energy budget levels are based on the assumption that building's classification will be static. However, many buildings are designed to accommodate changes in their initial uses or expansion during the building's life. For example, buildings initially designed to house retail areas may also be designed for easy conversion to office space or other classifications.

Retail facility uses can change because of variations in the product mix and in the accomparying alterations in display requirements. It is not uncommon for stocked storage areas to become display areas. As an example; in order to accommodate the maximum number of possible changes with minimum amounts of additional expense and construction, retail buildings usually incorporate mechanical and electrical systems with sufficient capacity to permit the movement and substitution of fixtures and equipment as the store plan is modified for particular tenants.

A similar situation occurs in facilities which provide for expansion, such as for a restaurant. In many of these cases, such as in a shopping mall or in a department store, alternate locations are designed for restaurants. This requirement affects, among other things such as water, sewer, electrical and gas capabilities, the HVAC primary and secondary equipment selection in that future capacities for the restaurant must be provided in several places, with a result that the building may be designed to accommodate multiple restaurants when, in fact, only one restaurant will be actually built and operated.

But, because the NOPR sets energy budget levels which are very low, the result may be that a designer cannot meet the budget with HVAC (or other) equipment selected to accomodate multiple uses. In order to meet the budget the designer may be forced to closely tailor the equipment selection to a specific but assumed tenant mix. Once the building in finally occuppied the owner may find it very expensive to satisfy a particular tenants' needs.

References

1. Technical Support Document #3, p.3.6.
2. Ibid.
3. National Lighting Bureau, Getting The Most From Your Lighting Dollar, pp.6-7.

Life Cycle Costing

Life cycle costing techniques are used by DOE to determine the optimum energy budget levels for single family attached and detached residential structures. This ambitious and complex approach is designed to insure that the budget levels selected are cost justified. In other words, the increased costs of the energy savings improvements should be balanced by the energy cost savings associated with those improvements when the time value of money is considered, such that the consumer will pay the lowest overall cost.

Life cycle costing is a valuable analysis tool, but it must be recognized that it is subject to limitations. In a study of life cycle cost methodology prepared for ERDA, one finds the following caution:

> ... the user should be cautioned that the analysis data inputs are often forecasts, estimates, assumptions, and sometimes guesses. It would be a mistake to carry the life cycle cost analysis to abnormally precise degrees. Life cycle costing is a tool which synthesizes data and contributes to making a logical decision, but it is not an end in itself.[1]

A careful analysis of some of the forecasts, estimates and assumptions explicit in the development of the residential budget levels reveals that many of these items are at worst grossly inaccurate and at best discriminate against the electric space heating market.

The life cycle cost analization technique requires that many variables be adequately defined. Some of the major variables are[2]:

- -- price of fuel for heating (1978 dollars/million Btu)
- -- annual (constant dollar) fuel escalation rate
- -- lifetime of mortgage
- -- efficiency of heating
- -- heating load (in million Btu/year)
- -- discount rate (constant dollar).

Price of Fuel for Heating

It should be noted at the outset that electricity is not a fuel. Electricity is an energy form that can be (but is not necessarily) produced using the energy released by burning fuels. Technically, in order to compare electricity to other fuels, only the price of the fuels used to generate electricity should be examined.

Nevertheless, heating fuel prices as used in this rule-making are based on national average estimates compiled by the Energy Information Administration. A national average price per million Btu is developed for natural gas, heating oil and electricity.

Using an average cost for electricity used for space heating purposes is grossly inaccurate. It is well known that electricity costs vary from utility to utility, and within each utility electricity costs vary in accordance with the season and in accordance with the daily load profile. The price of electricity when used as a heating power source is dependent on the capital requirements imposed on a particular utility to provide that service, as well as it is a function of the cost of the particular fuels used and other operational considerations.

Using average costs can cause serious inaccuracies, as illustrated by the following example. Most of the electric utilities in the United States are summer peaking, the peak demand for electric power occurs in the summer and is often a loose function of ambient temperature. This summer peaking characteristic is due to the fact that the preponderance of air conditioning in the United States is electrically driven.

Obviously, the maximum capital requirements for a summer peaking utility occur in the summer, not in the winter, since the utility must build and maintain adequate generation, transmission and distribution facilities to meet the peak demand. Likewise the capital component imbedded in electric rates will generally be higher in the summer than in the winter, causing summer rates to be higher than winter rates.

Two examples are offered illustrating the point. Residential service rate schedules for the Commonwealth Edison Company in Chicago, Illinois[3] and the Potomac Electric Power

Company in Washington, D.C.,[4] reveal that the additional per kwh cost for electric heat (i.e., the incremental rate for service in addition to basic usage of 500 kwh per month) is 2.225¢ and less than 2.5¢ respectively. By comparison, the cost per kwh for air conditioning is 5.919¢ and 3.78¢ respectively. This example does not take into account the complete cost of fuel (i.e., fuel adjustment charges) or taxes.

Electric utilities generally schedule generating units in accordance with economic dispatch. In other words, as a utility's power pool load grows, say on an hourly basis, the next cheapest generating source is called upon to serve the added load. Due to the high cost of oil, oil fired units are often the last units to be put on line.

The cost of fuel used by a utility is eventually reflected in electric rates, usually via a fuel adjustment clause. A summer peaking company is often able to provide electric heating energy using a minimal amount of oil, resulting once again in a general trend towards lower winter or heating rates relative to summer rates. The residential customer of such a company will very likely find that the incremental electric rate for space heating is substantially lower than the incremental rate for air conditioning.

Even in the case of winter peaking electric utilities the situation must be examined carefully. For some winter peaking companies, the capital requirements for transmission, subtransmission and distribution facilities may still be determined by summer loads. This is so because the current carrying abilities of transformers, conductors, etc., are to some extent dependent on ambient temperature. Even the effect of space heating on generating capacity must bear close scrutiny, since some winter peaking companies may be able to take advantage of the excess capacity of their summer peaking neighbors, and since some electric heat systems (notably thermal storage systems) may not contribute fully (or even partially) to the electric system peak demand.

Interestingly, the cost based pricing methods employed by summer peaking electric utilities are also often used by natural gas utilities. Natural gas utilities generally experience their peak demand in the winter, hence gas prices in the winter may be higher than the average annual price. Yet average gas prices were used in the life cycle cost analysis, a technique that leads to an unjustifiably high budget level selection.

The net result of this explanation is to illustrate that the use of any "annual average" cost for electricity introduces substantial error into the life cycle cost equation. Overall, for a summer peaking electric utility, the result of using "annual average" costs is to understate the annual fuel cost for air conditioning and to overstate the annual fuel cost for electric space heating. The true cost of electric power used for space heating should be taken on a company by company basis and it should be computed as the incremental cost in accordance with published residential rate schedules. Undoubtedly this is a complex approach, but it is necessary to avoid serious errors in a life cycle cost analysis.

Annual Fuel Escalation Rate

The annual fuel escalation rate used in the life cycle cost analysis was based on EIA Price Projections[5] using national average prices with an annual real escalation rate of 2.81% for natural gas and 1.54% for electricity.Evidently, oil price projections were not used in the life cycle cost analysis, although the price projections for oil are offered by EIA.

The average oil price forecast by EIA for 1985 is $4.79 per million Btu[6]. It is interesting to note that at this writing fuel oil costs over $7.25 per million Btu!

Certainly it is very easy in retrospect to criticize this energy price projection, but that is not the point. The point is that neither DOE nor anyone else can predict future energy prices with any reasonable degree of certainty. And yet, the life cycle cost methodology is highly sensitive to fuel price projections stretching out over a mortgage period of 30 years. Obviously, basing energy budget levels on highly speculative energy price projections introduces an element of uncertainty that is unsuitable for use in a national rulemaking. In addition, if relative differences between projected level costs are inaccurately estimated, higher than justified energy budgets may be assigned to a particular heating fuel relative to other fuels.

Efficiency of Heating

The efficiency of heating systems used in the life cycle cost analysis is discriminatory and unjustified.

The gas furnace efficiency used in the analysis is 0.70, "under the assumption of minimal (10%) duct loss and the use of efficient gas furnaces" (Economic Analysis, P. 4-15). This estimate of efficiency is unjustified for at least two reasons; it is too high and it is not a function of certain climatic variables. While an exhaustive explanation of gas furnace efficiency is not appropriate in this proceeding, a lengthy list of references adequately describing the matter are presented for review.

"A Method for Estimating the Seasonal Performance of Residential Gas and Oil-Fired Heating Systems"; prepared by Joseph Chi and George E. Kelly, ASHRAE member, ASHRAE Transaction, Vol. 84, Part 1, 1978

"Residential Energy Consumption; Single Family Housing"; final report, Report #HUD-HAI-2, Contract #H-1654; HUD; March, 1973.

"Energy Alternative-A Comparative Analysis"; prepared by the Science & Public Policy Program, University of Oklahoma for CEQ, ERDA, EPA, FEA, FPC, DOI and NSF; May, 1975.

"Energy Efficiency Program for Appliances: Home Heating Equipment, Furnaces and Humidifiers"; Project 9511, final report; prepared by Institute of Gas Technology for Booz-Allen-Hamilton, Inc. and FEA; November, 1977.

"Design, Development & Demonstration of a Promising Integrated Appliance"; Phase 1-Design, final report; prepared by Arthur D. Little, Inc. for ERDA; Contract #E-(04-3)-1209; September, 1977.

"The Electric Future"; prepared by V. A. Rydbeck, General Electric Company; December 1, 1977.

"The Relative Efficiencies of Gas, Oil & Electric Space Heat"; Energy Conservation Division, Office of Energy Programs; September 17, 1974.

"Heat Balance & Efficiency Measurements of Central Forced-Air, Residential Gas Furnaces", Report "ORNL-NSF-EP-88, Oak Ridge National Laboratory; October, 1975.

"An Analysis of Electric Resistance & Direct Combustion Space Heating Systems in Homes of Constant First Cost"; Office of Energy Systems, Federal Power Commission, September, 1975.

"Energy Usage and Relative Utilization Efficiencies of Oil-, Gas- and Electric-Heated Single-Family Homes"; prepared by V. S. Manina, member ASHRAE, and A. Juchymenko; ASHRAE paper No. 2365 of ASHRAE Transaction, Part II, Vol. 81, 1975.

"Fossil-Fuel Furnace Losses Detailed"; prepared by R. L. Dunning, Westinghouse Electric Corp.; "Electrical World"; November, 1974.

"Heat Balance & Efficiency Measurements of Central, Forced-Air, Residential Gas Furnaces"; Report #ORNL-NSF-EP-88, Oak Ridge National Laboratory, October, 1975.

"A Review of the Debate Over Electricity & Direct Fossil Fuel Space Heating"; Gordian Associates, Inc.; April, 1974.

"Energy Used & Energy Lost-How Electricity Compares with Other Energy Forms in Efficiency & Cost"; prepared by Wilfred H. Comtois and William H. Stinson, Westinghouse Electric Corp.; April, 1978.

"Seasonal Fuel Utilization Efficiency of Residential Heating Systems"; prepared by E. C. Hise, Oak Ridge National Laboratory; April, 1975.

"Analysis of Relative Efficiencies of Various Types of Heating Systems"; Report #PSP; prepared by R. L. Dunning, Dr. L. C. Geary, and S. A. Trumbower, Westinghouse Electric Corp.; October 30, 1973 (revised January 21, 1974).

"Relative Efficiencies of Gas Furnaces and Electric Heat Pumps"; prepared by Robert L. Dunning, Westinghouse Electric Corp.

"Heat Pumps: Substitutes for Outmoded Fossil-Fueled Systems"; prepared by Lockheed Missiles & Space Co., Inc. for Industrial Environmental Research Laboratory; April, 1977.

"State-of-the-Art of Energy Conversion Today and Tomorrow"; prepared by C. C. Burwell, Oak Ridge National Laboratory for APPA Engineering and Operations Workshop; March 12-15, 1973.

The estimates of heat pump seasonal performance factors (SPF) used in the life cycle analysis are greatly understated.[8] A 10% heat loss in insulated duct work is assumed.

A technical error is made in assuming that the duct loss for a heat pump will be the same as that of a gas or oil furnace. Due to the fact that gas or oil furnaces provide much higher supply air temperatures that heat pumps, their losses are higher. This point is well documented in many of the previously mentioned references.

It is important that in any side by side analysis of heat pumps versus gas furnaces that similar types of equipment be compared. For example, it is not appropriate that an "efficient" gas furnace be compared to a five or six year old builder model heat pump. Likewise it is not fair to compare a new high efficiency heat pump to an old gas or oil furnace. Yet it appears to be the case in the life cycle cost analysis that a high efficiency gas furnace is compared to a heat pump model exhibiting lack-luster performance.

As DOE undoubtedly knows, heat pump performance is not static. Manufacturers are continuing to develop and market higher efficiency models. By attempting to "fix" heat pump performance in the life cycle cost analysis, DOE is discriminating against this highly efficient and rapidly improving product. DOE'S energy use estimates for heat pumps are too high for today's models, and will be impossibly outdated by the time this rulemaking becomes emplaced.

A reference list concerning heat pump performance is presented for the Department's use. Also included are references dealing with advanced heat pumps, both gas and electric.

"Heat Pumps: Substitutes for Outmoded Fossil-Fueled Systems"; prepared by Lockheed Missiles & Space Co., Inc., for Industrial Environmental Research Laboratory; April, 1977.

"Energy Alternatives-A Comparative Analysis"; prepared by the Science & Public Policy Program, Univeristy of Oklahoma for CEQ, ERDA, EPA, FEA, FPC, DOI and NSF: May, 1975.

"Heat Pump Technology: A Survey of Technical Developments, Market Prospects & Research

Needs"; prepared by Gordian Associates, Inc., for Consumer Products and Technology Branch, ERDA; Contract #EX-76-C-01-2121; July, 1977.

"Gas and Electric Service in Multiple Housing"; prepared by Clifford A. Brandt, H. Zinder and Associates, Inc.; December, 1957.

"Savings in Energy Consumption by Residential Heat Pumps: The Effects of Lower Indoor Temperatures and of Night Setback"; prepared by R. D. Ellison, Oak Ridge National Laboratory; Con-4; January, 1977.

"An Investigation of Methods to Improve Heat Pump Performance and Reliability in a Northern Climate"; prepared by Westinghouse Electric Corporation for EPRI; EPRI EM-319, Project 544-1, final report, Vol. 1; January, 1977.

"The Electric Future"; prepared by V. A. Rydbeck, General Electric Company; December 1, 1977.

"Improvements in Cost and Efficiency Possible with Refined Heat Pump Systems"; Pg. 30, March 20, 1978 issue of Air Conditioning, Heating and Refrigeration News.

"Analysis of Relative Efficiencies of Various Types of Heating Systems"; Report #PSP; prepared by R. L. Dunning, Dr. L. C. Geargy and S. A. Trumbower, Westinghouse Electric Corp.; October 30, 1973 (revised January 31, 1974).

"Relative Efficiences of Gas Furnaces and Electric Heat Pumps"; prepared by Robert L. Dunning, Westinghouse Electric Corporation.

"Load and Use Characteristics of Electric Heat Pumps in Single-Family Residences; prepared by Westinghouse Electric Corp. for EPRI, EA-793, Project 432-1, final report, Vol. 1; June, 1978.

"Seasonal Fuel Utilization Efficiency of Residential Heating Systems"; prepared by E. C. Hise, Oak Ridge National Laboratory; April, 1975.

Advanced Gas Heat Pumps

"Research and Development Needs in Heat Pump Technology"; prepared by P. J. Reynolds, U. S. Department of Energy, and A. Lannus, Gordian Associates, Inc. Presented at the 1978 Oklahoma State University Heat Pump Conference.

"Heat Pump Technology: A Survey of Technical Developments, Market Prospects and Research Needs"; prepared by Gordian Associates, Inc., for Consumer Products and Technology Branch, ERDA; Contract #EX-76-C-01-2121; July, 1977.

Advanced Electric Heat Pumps

"Improvements in Cost and Efficiency Possible with Refined Heat Pump Systems"; Pg. 30, March 20, 1978 Issue of Air Conditioning, Heating and Refrigeration News; (Dual Speed Heat Pump).

"Seasonal Fuel Utilization Efficiency of Residential Heating Systems"; prepared by E. C. Hise, Oak Ridge National Laboratory; April, 1975.

"An Investigation of Methods to Improve Heat Pump Performance and Reliability in a Northern Climate"; prepared by Westinghouse Electric Corp., for EPRI; EPRI EM-319, Project 544-1, final report, Vol. 1; January, 1977.

"Improvements in Cost and Efficiency Possible with Refined Heat Pump Systems"; Pg. 30, March 20, 1978 Issue of Air Conditioning, Heating and Refrigeration News; (Single Speed Heat Pump).

The prior explanation of heating system efficiencies is a useful exercise, but perhaps here again the point is not the fact that DOE has failed to use the proper efficiencies. The point is that there is now and there will continue to be a great deal of uncertainty concerning just what the real efficiencies are. Yet the life cycle cost analysis is highly sensitive to this uncertainty!

Heating Load

It would seem that the heating load calculation input to the life cycle analysis should be beyond reproach. But even in this narrow technical area one can find uncertainty.

For example, on page A-19 Economic Analysis the statement that no heat flow occurs between a basement and the conditioned area (or living space). The assumption is that the basement walls are insulated and that heat gains from appliances in the basement yields an ambient temperature of 70°F.

A great deal of uncertainty surrounds this assumption since no correlation exists between the frequency of ownership of second refrigerators or freezes and the frequency of basements. Also left open is the question of whether or not the heat gains assigned to maintaining 70°F in the basement were also counted as heat gains to the living space. If these heat gains were in fact "counted twice", the result is a design energy budget that is too low. Since only one internal load schedule is presented, one can only assume that the same internal load schedule was applied to all homes, with or without basements.

The DOE-II computer program is used to estimate the heating load. This is a relatively new energy analysis program that has not yet achieved acceptance in the design community and has not yet been publicly verified.

EEI, in attempting to gain familiarity with the program and to gain some insight into the actual strictness of the energy budget levels, retained the services of a Washington, D.C. engineering consulting firm for the purpose of performing DOE-II runs on the DOE prototypical home in various regions of the country.

The results of these runs yielded two conclusions, that the DOE-II energy consumption estimates do not correlate with ASHRAE techniques and that DOE-II heating energy estimates are low, possibly due to the program allowing excessive credit for solar gains.[9] Based upon the results of this study and upon private conversations with others experienced with the program, we believe the DOE-II computer program is not yet sufficiently accurate to be used in a Federal rulemaking. It is, at this point in time, an understatement to charge that the DOE-II computer program injects a great deal of uncertainty into the life cycle cost analysis.

Discount Rates

A discount rate expressed in real (i.e., constant dollar) terms is assumed to be 3%[10] This rate, when the Economic Analysis document was prepared, corresponded to a 10% or 11% discount rate when expressed in current dollars. Underlaying this assumption is an inflation rate of 8%.

One can only wonder what discount rate is appropriate in light of current inflation rates (18%) and current mortgage rates (17%).

Trying to assume appropriate discount rates for the near term future may be as difficult as predicting energy prices. Again, the point is that this is yet another area of uncertainty.

Summary

The net result of this critical exercise is not to nit-pick the highly questionable forecasts, estimates and assumptions that went into the life cycle cost analysis. Rather it is intended that these comments illustrate that the life cycle cost process is an uncertain process, and is not suited for forming the technical basis for a national rulemaking. Life cycle costing is a valuable tool, but it is not an end in itself, and therefore should not be the sole technical basis for energy budget level selection.

Additionally, any effort to extend this uncertain process to commercial buildings is ill-advised. The uncertainty of the assumptions used in the residential analysis is even greater when applied to the more complex situations presented by commercial structures. Of particular volatility would be assumptions made concerning the discount rates and tax effects.

References

1. Reynolds, Smith and Mills, Life Cycle Costing Emphasizing Energy Conservation Guidelines for Investment Analysis, ERDA-76/130 Rev.
2. "Economic Analysis", pp. 4-14.
3. Commonwealth Edison Company "Electricity for the Cities and Village within its Service Area", February 7, 1980.
4. Potomac Electric Power Company, "Rate Schedule for Electric Service in the District of Columbia", July 24, 1979.
5. Federal Register, April 30, 1979.
6. "Economic Analysis", pp. 5-9.
7. Ibid, pp. 4-15.
8. Ibid, pp. 4-24.
9. Enviro-Management and Research, Inc., "Heating Degree Day Study."
10. "Economic Analysis", pp. 4-18.

Standard Evaluation Technique

There are several serious problems associated with the use of the standard evaluation technique, and in particular, with the DOE-II computer program which is used to calculate the design energy consumption.

A. The comparability of the DOE-II program to other computer programs used for Phase One and Two research has not been established.

The energy consumption projections that have been derived in Phase I and Phase II research may substantially vary depending on the computer program employed. For example, in the Phase Two/Final Report, the variances in one study were reported to be up to 35%.[1]

The redesign effort relied on the AXCESS/SHIS long-form computer program to quantify savings possibilities which subsequently were applied to derive design energy budgets. DOE has not performed any research to indicate design energy budget differences had calculations of redesigned energy consumption had been performed through the use of DOE-II computer program. Because no such research has been completed, there is no way of knowing the degree of variance that can be anticipated. Using the DOE-II computer program to estimate design energy consumption and then comparing this estimate to a budget developed using a different program is inappropriate unless engineerng equivalency between the two programs is established. In the absence of established equivalency, either design energy consumption should be calculated using AXCESS/SHIS or design energy budgets should be recalculated using DOE-II, assuming DOE-II is modified to be accurate enough to perform this task.

B. The accuracy of the DOE-II program has not been verified.

Because the engineering accuracy of the DOE-II program has not been verified, one cannot assume that this program performs energy-use estimations accurately. Enviro-Management and Research, Inc., a Washington, D.C. consulting firm, used DOE-II to simulate the energy performance of DOE's prototypical single-family house located in Washington, D.C. and in other areas of the country.[2] The Washington, D.C. house was designed to include R_{38} insulation in the ceilings, R_{27} in the walls and triple glazing. The heating system was assumed to be an electric heat pump.

The DOE-II program projected a design energy consumption of 31.49 MBtu/ft.^{2}/yr. Enviro-Management and Research, Inc., al.o developed projections for the same structure using manual calculation procedures recommended by the American Society of Heating, Refrigeration and Air Conditioning Engineers. Using the ASHRAE manual technique the projected energy consumption was 47.46 MBtu/ft.^{2}/yr., for the same structure. There is obviously a great discrepancy between the two calculation methods.

This comparison was extended to include other cities, the results of this comparison are shown in Table 20. The conclusions that are directly drawn from these comparisons is that there is no correlation between DOE-II and ASHRAE estimates, and that DOE-II estimates are generally far lower than ASHRAE estimates. It should be noted that although DOE-II is far more sophisticated than

TABLE 20:
ENERGY CONSUMPTION COMPARISON-KWH

	ASHRAE MANUAL HEATING DEGREE DAY METHOD 65° BASE	DOE-II COMPUTER RUNS
Atlanta, GA		
19-11-11-1	25,279	6539
38-19-11-3	17,720	3228
Chicago, Ill.		
30-11-0-2	18,560	11,262
38-23-0-3	15,872	7,622
Ft. Worth, TX		
19-11-p-1	11,951	4,475
38-23-p-3	9,060	1,788
Fresno, CA.		
19-11-p-1	11,571	4,009
38-19-p-1	8,551	1,767
Houston, TX		
19-11-p-1	6,510	2,698
30-19-p-3	4,965	1,060
Miami, Fla.		
19-11-p-1	945	251
38-19-p-2	726	15
Minn., Minn.		
30-11-0-2	25,213	17,884
38-27-0-3	21,521	12,616
Phoenix, AR		
19-11-p-1	7,681	1,486
38-27-p-3	5,466	327

TABLE 30 Cont.
ENERGY CONSUMPTION COMPARISON-KWH
CONT.

	ASHRAE MANUAL HEATING DEGREE DAY METHOD 65° BASE	DOE-II COMPUTER RUNS
Portland, OR		
19-11-11-2	16,736	10,726
38-27-11-3	14,111	6,870
SanFran. CA		
19-11-p-1	15,181	5,800
38-23-p-2	11,173	3,137
Portland, ME		
30-20-0-2	20,038	12,016
38-27-0-3	18,108	9,025
Wash., D.C.		
30-11-0-2	12,386	6,602
38-27-0-3	10,525	3,992

ASHRAE manual techniques, the ASHRAE method is in part based upon practical experience and is generally regarded to yield estimates that at least approximate actual performance.

Based upon work performed by Enviro-Management and Research and upon private conversations with other DOE-I. users, it appears there are serious errors in either the load calculation or the energy estimating portions of the DOE-II program. Specifically it appears that the program is granting excessive credit for solar gains, leading to an overly reduced heating energy requirement.

Due to grave suspicions concerning the accuracy and validity of the DOE-II program, the appropriateness of the Standard Evaluation Technique becomes questionable since DOE-II is its centerpiece. Of particular concern is DOE's plan to accept other calculation methods based on comparability to DOE-II.

C. Relatively few design professionals have experience with computer applications.

Because of the computer capability required in the Standard Evaluation Technique, the broad impact of BEPS, when implemented, will require virtually all design professionals involved with energy related building systems to develop computer capabilities or face a dramatic dropoff in business. The American Consulting Engineers Council estimates that no more than 20% of the nation's design professionals have computer capability.[3] In addition, according to data developed by the U.S. Bureau of the Census, most consulting engineering firms are small, employing ten persons or less. DOE has not performed any research to determine the degree to which the small firms will be able to develop the capital necessary to attain computer capability, and/or the time required to attain knowledge of the computer program. The standard evaluation technique is written such that many more building types, including single-family residences, will require the input of design professionals. The demand for additional design professionals will be increased still further by jurisdictional requirements for additional personnel to implement review of the BEPS developed houses and buildings. However, as previously stated very few of the professional community have any experience with computer programs, let alone in depth experience. As a result, implementation of BEPS will be a substantial disruptive force among the nation's community of design professionals.

It should also be noted that those design professionals who have computer capability and knowledge are not familiar with the DOE-II program. As such, a massive educational effort will be necessary and DOE has not performed any study to determine whether or not this educational effort can be developed or how it will be funded. In summary, the design professional community is not prepared to be strapped into using a computer program such as DOE-II at this time.

D. Limitations of the DOE-II Program makes its utility highly questionable.

The DOE-II Program is incapable of simulating the performance of certain types of commercial systems which are seen in today's industry. These include:

1. Rooftop units
   - a. Single-zone
   - b. Muti-zone
   - c. Variable air volume

   cooling: air cooled condenser with reciprocating compressor

   heating: gas, oil, hotwater, steam or electric resistance
2. Packaged terminal airconditioners
   - a. DX electric resistence
   - b. air-to-air heat pumps
   - c. water-to-air heat pumps

Modeling limitations also include heat recovery systems such as heat wheels (sensible/latent), run-a-round and heat pipes. Also excluded are important systems such as heat-pump water heaters and zoned residential heating systems, heating/cooling thermal storage sytems, a variety of energy management devices and control systems designed to minimize both energy consumption and electrical demand, solar residential cooling systems and wood (or coal) burning furnaces, stoves and boilers.

The DOE-II program lacks the capability of handling individual metering in multifamily residences. Individual metering is an energy conservation option where actual energy savings have been realized and documented.

There is also a limitation concerning the handling of equipment efficiences by the DOE-II computer program. The current version of DOE-II contains a rather detailed routine for estimating air conditioning energy requirements based upon outdoor conditions. Yet gas (and oil) furnace efficiencies are inputted as a single-number seasonal efficiency. It appears inconsistant that the effect of weather on air conditioning performance is considered while the effect of weather on heating system performance is not, particularly since overall more energy is consumed heating than is consumed cooling.

E. DOE has seriously underestimated the costs of using DOE-II. The cost impact will be far more substantial than DOE has assumed.

According to the technical support document, Standard Evaluation Technique:

> "Computer simulation programs are the costliest of all calculation procedures to learn and use. For example, both BLAST-II and DOE-II require three to four weeks for design engineers to learn how to use them because of the nature and sophistication of these procedures. The cost of using these programs also varies by building complexity. A simple residence can be input to the program and run in less than one day by a knowedgeable user, for a computer cost of $10 to $12 for DOE-II, or $22 to $25 for BLAST. However, for the larger complex buildings, the information gathering and input time can be two to three weeks and the cost of the computer run can be several hundred dollars. An average computer cost per building zone might be $20 for DOE-II and $30 BLAST-II. However, when input time by a professional is considered, for example, $15 per hour, the total simulation expenditure might be in the range of $125-135 per building zone. Proprietary programs available in the private section, either for direct use by the user or through an energy analysis service, may range higher or lower than the cost in the

example above due to the nature, complexity or purpose of the computer simulation."[4]

The source of DOE's time and cost estimates are unknown. It is known, however, that they have not been based on actual experience or control studies of any type. From analysis of the DOE-II program, it seems somewhat naive to assume that a design engineer can learn the intracacies in three or four weeks, because the program entails some 2,200 pages of documentation and 28,000 lines of code. According to the design community, six to eight weeks is a far more appropriate assumption and even that may be somewhat low, considering that most design professionals have little or no experience even in rudimentary computer methods, let alone the complex DOE-II Program. Even if the three to four week period were accurate, one must ask where design professionals will find the time to take the required courses necessary to understand the DOE-II Program.

The assumption that input time for larger, more complex buildings will amount to only two to three weeks a period is inaccurate. Enviro-Management and Research's experience indicates that the time required for input may be from four to five weeks.[5] The cost for this time will be quite substantial. At $15 per hour it would amount to as much as $3,000. However, the DOE assumption of $15 per hour is low. According to the Consulting Engineers Council of Metropolitan-Washington, in which a survey of personnel salaries of consulting engineer firms, the lowest level engineer (graduate engineer without P.E.) was earning approximately $9 per hour in 1980.[6] Most firms compute overhead and profit as a multiplier from 2.75-3.5 resulting in hourly charge of almost $25 more. Furthermore, the assumption that the lowest level engineer of the firm would be doing the work may be inaccurate. For the next two levels of engineers the hourly fees range from $35 to $44 and $41 to $52 respectively.[7] In other words, owners may be required to pay as much $10,000 or more for gathering the data necessary for DOE-II input. This is only the input time, it does not include the additional time required for reruns due to the inability of the first attempt to meet the design energy budget. This also does not include reruns needed to identify projected actual energy consumption using likely actual operating conditions instead of the standard building operating conditions.

F. Many areas of the United States are not adequately covered by the weather data used with the Standard Evaluation Technique.

Building designs should be sensitive to local climatic conditions in order to minimize energy consumption. This may be discouraged since design energy consumption must be calculated and compared to the standards for the nearest designated design station, and in some cases the nearest station may not be representative. For an example, the weather conditions in Berkley, California and Walnut Creek, California are dramatically different although the two locations are separated only by a tunnel running through a mountain.

References

1. Phase Two/Final Report, p. 6.7.
2. Enviro-Management and Research, Inc., DOE-II Analysis of a Protypical House, April 1980.
3. Donald G. Carr, on behalf of the American Consulting Engineers Council, March 24, 1980, p. 71.
4. Technical Support Document #1, pp. VII, 19-VII, 20.
5. Enviro-Management and Research, Inc., An Analysis of Notice of Proposed Rulemaking: Energy Performance Standards for New Buildings, April 4, 1980, pp. 5.10-11.
6. CEC/MW Business Practices Survey, 1978-1979.
7. Ibid.

Standard Building Operating Conditions

Although the need for a standard building operating conditions (SBOC) approach is obvious due to the construction of BEPS, SBOC create a variety of problems, some of which may be counterproductive to the goal of energy conservation.

A. Standard building operating conditions will virtually eliminate the use of decentralized zonal electric space heating systems.

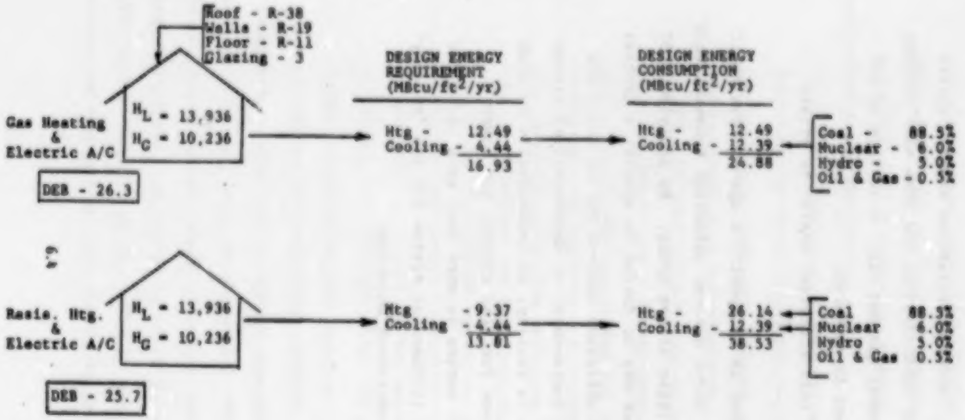
Most space conditioning systems used in single family residences are central systems which are governed by a single thermostat. Because a single thermostat is used to control the temperatures for an entire house, certain spaces typically are overheated while others are underheated. Overheating is an obvious waste. However, underheating can result in even more waste, since the natural reaction is to "turn up the thermostat" to compensate for the reduced temperatures.

Zonal electric space heating systems are typified by electric resistance baseboard units, each of which is individually controlled. In the past, the use of the systems has generally been associated with high energy use. However, numerous studies suggest that the expense involved has been associated with less than efficient operation of the units, lack of insulation and/or weatherstripping or a combination of other related factors. Current practice in new home construction will eliminate the efficiency losses associated with poor construction. In addition, newly developed "smart" master control systems will help eliminate waste associated with the operations of the units. In fact, it is now possible to control all the individual heating units from a single location and to program the use to assure that the temperature set point in each unit is reduced when appropriate or the unit is de-energized. In addition, baseboard units do not suffer the "parasitic" losses associated with ducting and piping which DOE estimates comprises as much as 15%.

Due to the way in which SBOC are specified, it is not possible to take the controllability advantages of decentralized zonal electric heating systems into account, thereby making it virtually impossible to use these systems in any new buildings.

To show an example of the previous situation consider a home in Atlanta, Georgia, which must be designed to meet a design energy budget of 26.3 MBtu/ft.^{2}/yr. using gas heat or 25.7 MBtu/ft.^{2}/yr. using electric heat. Given the heating and the cooling loads shown in Figure 4, the design energy budget can be met comfortably when gas heat is specified. However, if electric resistance heating is specified, the design energy budget is exceeded by approximately 50%, making it impossible to specify decentralized zonal space heating despite the fact that the actual energy consumption, because of the controllability advantage, is likely to be much lower than that assumed by SBOC. It is interesting to point out that, even assuming that SBOC assumptions are valid, the use of electric resistance heating for this example house would result in far less consumption of critical energy sources (i.e., natural gas and oil). With gas space heating and electric air conditioning the home will consume approximately 12.6

FIGURE 4


ATLANTA
Roof - R-38
Walls - R-19
Floor - R-11
Glazing - 3
Gas Heating & Electric A/C
H_L = 13,936
H_G = 10,236
DEB - 26.3
DESIGN ENERGY REQUIREMENT (MBtu/ft^2/yr)
Htg - 12.49
Cooling - 4.44
16.93
DESIGN ENERGY CONSUMPTION (MBtu/ft^2/yr)
Htg - 12.49
Cooling - 12.39
24.88
Coal - 88.5%
Nuclear - 6.0%
Hydro - 5.0%
Oil & Gas - 0.5%
Resis. Htg. & Electric A/C
H_L = 13,936
H_G = 10,236
DEB - 25.7
Htg - 9.37
Cooling - 4.44
13.81
Htg - 26.14
Cooling - 12.39
38.53
Coal 88.5%
Nuclear 6.0%
Hydro 5.0%
Oil & Gas 0.5%

Savings of critical resources (oil & gas)

Gas heated house consumption $(12.49 + (12.39 \times .005)) = 12.55$ MBtu/ft^2/yr x 1176 ft^2 = 14,758,80

Resis. heated house consumption - $(38.53 \times .005) = 0.193$ MBtu/ft^2/yr x 1176 ft^2 = 226,96

Savings - 14,531,832

MBtu/ft.^{2}/yr. of natural gas. With decentralized zonal electric space heating and electric air conditioning, the home will consume only .21 MBtu/ft.^{2}/yr. of natural gas and oil: a savings of 98% of those fuels the nation needs to conserve.

B. SBOC may encourage less efficient design to attain compliance.

For example, suppose a designer is to specify a speculative small office structure intended to serve several potential tenants, each of whom has different or variable office hours. By applying SBOC to this structure the designer may be forced to specify a central system HVAC scheme, since an efficient central system would use less "design energy" than an incremental or decentralized system under these conditions. But in reality, an individually metered incremental HVAC system may use far less energy, the lower efficiency of the incremental system is more than made up by the operating flexibility of the incremental system and the "honesty" of operation encouraged by individual metering.

C. Use of standard building operating conditions will add additional cost to building design.

According to the technical support document "Standard Building Operating Conditions";

> "It is DOE's observation that the operating conditions specified by design teams for building type may not be the operating conditions desired by a designer attempting to comply with the standards. In some cases it may be that the real intended use of a building design is well defined in its proposed operating conditions or at odds with the SBOC specified for use with the evaluation technique. In practice, the building designer may use the standard evaluation technique first as a design tool to determine the buildings design energy consumption under the desired operating conditions, and then perform an additional simulation using the SBOC required by the NOPR. . . (It) is the building designer, and ultimately the building owner who must bear the economic burden in assessing the building DEC under both conditions."[1]

The cost of the additional computer run associated with identifying actual likely energy consumption for a building in light of real conditions as opposed to SBOC can be as much as $1,000 for single family residence and as much as $3,500 for more complex structures.[2] It should be noted of course that several computer runs are likely to be needed to consider different approaches and attempts to achieve the design energy budget.

D. Use of Standard Building Operating Conditions will inhibit the use of innovative approaches.

DOE recognizes that the specification of standard building operating conditions will inhibit application of a number of the most advanced energy conservation approaches:

> "DOE feels that the main problem area in the exact specification of indoor temperature conditions is that, under certain circumstances, the flexibility of the building design process may be hampered. For example, passive solar energy systems typically utilized intentional, wide, indoor temperature swings to maintain comfort conditions. Because a passive solar building often utilizes the effect of mean radiant temperature from its thermal storage components, the occupants can be comfortable under varying, and lower, air temperature conditions. Also, adequate air movement under high temperature conditions may provide a valid energy conservation strategy which maintains comfort conditions."[3]
>
> "DOE is aware that the exact specification of standard building operating conditions for use with the standard evaluation technique inhibits the use of either example given. There are probably many other examples which could be pointed out as valid energy conservation strategies which rely on the intentional manipulation of dry-bulb temperature, humidity, mean radiant temperature and air movement to maintain comfort conditions.

> It is DOE's observation that these strategies are not commonly used incurring current building design practices and that they are exception rather than the rule."[4]

DOE's attempt to excuse this serious problem by indicating that innovative strategies are "not commonly used" and are "the exception rather than the rule" is troublesome in this extreme.

The nation desperately needs more innovative approaches to energy efficient design; innovative approaches are broadcast throughout the design community through a variety of journals and other publications, and could be learned quickly. However, the use of SBOC will inhibit their development thereby helping to assure that innovative approaches will remain the exception. In addition, DOE itself believes that building energy performance standards should be designed for energy technologies not yet existent, unfortunately it appears that SBOC is contradicting this intent.

DOE states that it "is considering the capability to simulate the effect of several of these types of energy conservation strategies with the standard evaluation technique.[5] However, it does not define which systems are involved, nor does it state or offer any method of attaining its desire "to encourage the valid use of creative approaches to maintaining comfort conditions while conserving energy."[6] It may be impossible to develop computer programs which can simulate the performance of systems which have not been created.

References

1. Technical Support Document #5, p.4.2.
2. Enviro-Management and Research, An Analysis of Notice of Proposed Rulemaking, Energy Performance Standards for New Buildings.
3. Technical Support Document #5, p.4.2.
4. Ibid.
5. Ibid.
6. Ibid.

Summary

We believe that the problems currently surrounding BEPS are severe enough to make it virtually impossible to promulgate the rule in its current form. We would like to offer several suggestions of things that could be done to stay within the intent of Congress and to remove many of the concerns that we and other groups have with the proposed rule. First and foremost of these would be to abandon the weighting factor approach or any attempts to incorporate the source energy considerations into the budgets. We also realize that site based energy budgets which would be the logical next step pose certain inequities between different energy forms. These inequities stem from the fact that some energy forms are converted with losses occuring at the building site while other such as electricity or steam, incur conversion losses at some remote off-site location. If the budgets could be recalculated slightly downward so as to reflect the energy used by the building and its systems and not include any conversion losses that occur on site, we would then have a situation in which parity exists between the different energy supplies with no advantage to anyone. This approach would apply to commercial buildings. For residential structures, the budgets could be equal to the heat loss of the structure regardless of what energy conversion systems were installed within the structure. These minor modifications would strip away a major portion of the concerns surrounding the budgets in the standard.

Secondly, we feel that another approach for deriving budgets would be recalculate them based on ASHRAE Standard 90. Since 42 of our nations state governments have adopted ASHRAE Standard 90, in one form or another, as an energy standard, with the encouragement of the Department of Energy, it's only logical to continue the reliance on this fine standard which has been developed by voluntary consensus procedures. If the prototypical buildings were recalculated using the first nine chapters of ASHRAE Standard 90 the resulting energy budgets would be exactly equivalent to existing state standards and would make the task of drafting implementation regulations not only possible, but perhaps even workable. If it becomes necessary to further reduce the budgets to effect additional energy conservation, it could be accomplished by merely reducing the budgets below the results of ASHRAE by some fixed percentage, like 5, 7 or 10 percent every several years in accordance with a published schedule.

Use of the foregoing approaches would, we believe, enable DOE to quickly complete the final rule, comply with the intent of Congress and reduce the overall sense of frustration that exists in all sectors impacted by the proposed rule. We hope our comments will receive favorable consideration by the Department. If we can be of any additional service, we would be glad to expand on any portion of our comments.

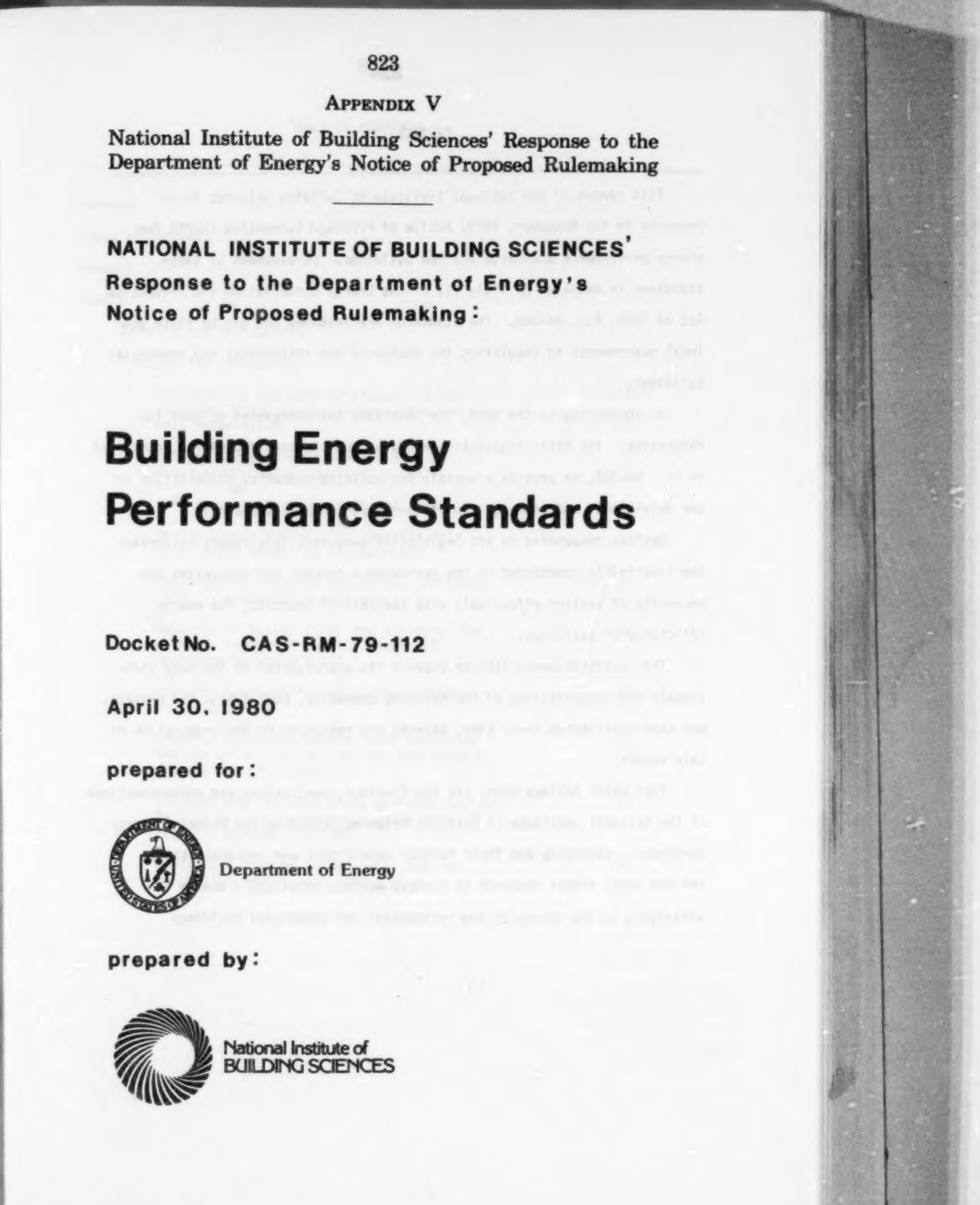
Respectfully submitted,

Paul C. Greiner

Paul C. Greiner
Vice President

APPENDIX V

National Institute of Building Sciences' Response to the Department of Energy's Notice of Proposed Rulemaking



NATIONAL INSTITUTE OF BUILDING SCIENCES'
Response to the Department of Energy's
Notice of Proposed Rulemaking:

Building Energy Performance Standards

Docket No. CAS-RM-79-112

April 30, 1980

prepared for:

Department of Energy

prepared by:

National Institute of
BUILDING SCIENCES

PREFACE

This report of the National Institute of Building Sciences is in response to the November, 1979, Notice of Proposed Rulemaking (NOPR) for energy performance standards for new buildings. Development of these standards is mandated by Title III of the Energy Conservation and Production Act of 1976, P.L. 94-385. The standards are intended for use by state and local governments in regulating the design of new residential and commercial buildings.

In responding to the NOPR, the Institute has endeavored to meet two objectives: its basic legislative mandate, and the specific charge, contained in P.L. 94-385, to provide a vehicle for building community consultation on the development and promulgation of energy performance standards.

Besides responding to its legislative mandates, this report reiterates the Institute's commitment to the performance concept and recognizes the necessity of dealing effectively with the task of improving the energy efficiency of buildings.

The Institute would like to express its appreciation to the many individuals and organizations of the building community, both public and private, who have contributed their time, talents and resources in the preparation of this report.

That which follows then, are the findings, conclusions and recommendations of the National Institute of Building Sciences regarding the proposed energy performance standards and their further development and implementation, and the total effort required to achieve maximum practicable energy efficiency in the design of new residential and commercial buildings.

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SUMMARY

The National Institute of Building Sciences (NIBS) supports the development of energy performance standards for new buildings as defined in the Energy Conservation and Production Act of 1976, (P.L. 94-385) and commends the Department of Housing and Urban Development and subsequently the Department of Energy, for their efforts to carry out the difficult task of developing such performance standards within the severe time and resource constraints imposed. However, it is the considered view of the Institute that the proposed standards will not achieve their stated goals and may, in fact, detract from the progress that has been and is being made in improving the energy efficiency of new buildings through existing state and local regulation and building community initiatives.

RECOMMENDATIONS

Based upon its review of the Notice of Proposed Rulemaking (NOPR) and supporting documentation, and broad-based input from the building community concerning the proposed standards, the Institute makes the following recommendations regarding the future development of the energy performance standards for new buildings.

Defer Issuing The Standards

Promulgation of BEPS should be deferred until the technical and structural deficiencies in the proposed standards have been corrected and the manner in which they will be implemented has been determined, even though this will require a delay well beyond the present legislatively mandated promulgation date of August 14, 1980.

Develop Revised Standards

To assure that BEPS and the accompanying implementation strategy will receive national acceptance and support when completed, further planning and work on the total program should be carried out in full consultation with the building community as called for in P.L. 94-385. The total program should be implemented with all deliberate speed and have as its objectives:

- Correcting the current technical and structural deficiencies in BEPS.
- Developing a BEPS implementation strategy and program that will minimize administrative costs and disruption of the normal building regulatory process at the state and local levels.

Further, during the course of developing the revised standards and implementation strategy and program, particular attention should be given to:

- Allowing alternate paths for satisfying the requirements of the standards - e.g., subsystem and component performance standards, and prescriptive standards and/or manuals of accepted practice, that most building community participants are accustomed to and currently better equipped to work with.
- Reassessing the concept of weighting factors to determine whether they are of direct significance to building performance, and if it is found that they are not, eliminating them and then assuring that the standards do not otherwise artificially bias the selection of fuels or the selection of heating and cooling equipment.

Promulgate On A Voluntary Basis

At the time of publication of the final standards, the Administration should recommend to Congress that consideration of sanctions be deferred until the building community has had sufficient time to respond to the final standards on a voluntary basis and until the necessity of applying the standards as mandatory requirements has been reassessed.

Parallel Supporting Efforts

In order to sustain the continued development and application of energy conservation standards and to facilitate the introduction of energy performance standards, incentives and other assistance should be provided for the following purposes:

- To enable states that have adopted building energy standards to update and strengthen those standards and to provide for their universal acceptance and enforcement;
- to encourage states that do not have energy conservation standards to adopt such standards immediately;
- to encourage states that have adopted standards for only certain types of buildings to expand their coverage to all new construction; and
- to enable appropriate institutions to initiate educational and training programs in the application of performance standards for building code officials, design professionals, builders and other members of the building community.

CONCLUSIONS

The foregoing recommendations are based on the following conclusions:

1. Neither the Design Energy Budgets (DEB's) nor the Standard Evaluation Technique (SET), as presently constituted, satisfy the basic requirements for a viable performance standard.
2. The proposed weighting factors will, in some instances, produce economic, environmental, and energy impacts that may be inconsistent with national goals and undermine the statutory requirement that the Building Energy Performance Standards (BEPS) encourage the use of non-depletable resources.
3. The original estimate of the potential energy savings of BEPS reported to the Congress at the time of enactment of P.L. 94-385 is no longer valid. Current DOE estimates of potential energy savings are significantly lower than the original projections. Also, the limited cost data available suggests that the public and private costs of implementing the proposed standards, which have not been adequately addressed in the DOE estimates,

will be significant and will adversely affect the anticipated benefits of the standards.

4. The BEPS will have significant economic, financial and legal impacts on key private and public sectors of the economy and specific geographic regions. These impacts have not been assessed in the detail necessary to either determine their true magnitude or to identify ways to mitigate their adverse effects.
5. The proposed standards have been developed without taking full advantage of the technical resources of the building community.
6. The current statutory mandate that state and local governments adopt and implement BEPS within one year after promulgation is unreasonable and impossible to achieve.

In developing this response to the NOPR, the Insitute sought the widest possible building community participation. Advice was provided by the Institute's 205-member BEPS Advisory Panel. The Institute also conducted two conferences, attended by over 120 representatives of the building community, at which the issues raised by the NOPR were identified and positions on the proposed standards were discussed. In addition, the Institute reviewed over 1,000 pages of testimony, research, and analyses provided to it by the building community.

Notwithstanding these efforts to develop and then consider as many points of view as possible, the Institute does not represent that either its recommendations reflect all positions taken by others on the proposed standards or all of the comments on those standards that have been or could be made. Accordingly, this presentation should not be construed as superseding the response to the NOPR of any other group. In summary, although there are strong divergent views on some issues, NIBS is confident that its assessment and recommendations fairly reflect the prevailing views of the diverse constituencies that make up the building community.

OVERVIEW AND METHODOLOGY

In responding to the Notice of Proposed Rulemaking (NOPR) for Energy Performance Standards in New Buildings, the National Institute of Building Sciences (NIBS) has endeavored to meet two objectives: its basic legislative mandate, and the specific charge, contained in P.L. 94-385, to provide the building community with a means for providing consultation on the development and promulgation of Federal performance standards.

The Institute's enabling legislation, Section 809 of the Housing and Community Development Act of 1974, P.L. 93-383, calls for NIBS to become an authoritative source of findings and advice to both the public and private sectors with respect to the use of building science and technology in achieving nationally acceptable standards and other technical provisions for use in Federal, state and local housing and building regulations. Further, the legislation encourages Federal agencies to accept, use and comply with the technical findings of the Institute.

In the Energy Conservation and Production Act of 1976, P.L. 94-385, the Department of Housing and Urban Development, and subsequently the Department of Energy, are directed, to the maximum extent practicable, to use the Institute as the means of consulting with appropriate representatives of the building community, appropriate public officials and organizations of public officials and with representatives of consumer groups. Although the Institute was not involved in the development of the proposed role, it has attempted to use these comments on the NOPR as a means of providing the building community's input to the further development of the standards.

Key to the development of the Institute's response to the NOPR was the participation of its Board of Directors (Appendix A), the Institute's

Building Energy Performance Standards (BEPS) Advisory Panel (Appendix B) and the building community at large. Development of the response was directed by the Energy Affairs Subcommittee of the Board. This seven-member subcommittee, chaired by Professor Rudard A. Jones, Director of the Small Homes Council - Building Research Council of the University of Illinois at Urbana-Champaign, in conjunction with the BEPS Advisory Panel, developed the overall strategy for the preparation of the Institute's response.

In its enabling legislation, the Institute is also directed to establish a Consultative Council consisting of representatives of all appropriate private trade, professional and labor organizations; private and public standards, code and testing bodies; public regulatory agencies; and consumer groups. The purpose of this Council is to insure a direct line of communication between these groups and the Institute. As part of each project undertaken by the Institute, an Advisory Panel is formed from the membership of the Council, its purpose to provide advice and counsel on the specific work being performed.

An Advisory Panel was created in response to the contract for BEPS implementation-related research awarded to the Institute by the Department of Energy in mid-1979. The activities of this 205-member panel are coordinated by a 14-member Steering Committee. It was chaired by Thomas Casberg of the Office of the Deputy Assistant Secretary for Installations and Housing for the Department of Defense until March 28, 1980, when David Smith, President of Harmony Hall Development Corporation and an Area Vice President of the National Association of Home Builders, assumed this role.

The Panel provided the viewpoints of a diverse cross section of the building community as input to the development of the Institute's position on the NOPR. Further, the Panel developed the approach for obtaining the widest possible building community participation in the formulation of the comments. Specifically, the following steps were taken to obtain the input of the building community:

- The Institute identified the major professional societies, trade associations, consumer groups and other organizations in the building community that it felt would be affected by or interested in Federal energy performance standards for new buildings (Appendix C). These groups were contacted and invited to participate in the development of the Institute's response to the NOPR. It was explained that the Institute intended to formulate its comments with the greatest possible participation of the building community.
- Representatives of 36 of the organizations contacted and 27 representatives of individual companies and other entities (Appendix D) met on February 21-22, 1980, to identify and discuss the issues raised by the NOPR. In the course of this meeting approximately 200 issues relating to the derivation of the proposed standards, their impacts on the building design process and their implementation were documented. Further, participating organizations were requested to provide the Institute with copies of their comments on the proposed standards and any research or analyses performed to support their comments.
- On March 27, 1980, representatives of 58 building community organizations (Appendix E), many of whom had participated in the meetings of February 21-22, reconvened to review proposed findings and conclusions based on the Institute's preliminary analysis of the comments and research that had been provided to it. Of specific importance was the guidance obtained regarding the availability of substantiation for the preliminary findings.
- Subsequent to the meeting, the Institute performed a detailed analysis of the approximately 1,000 pages of testimony, research reports and analyses provided to it by approximately 70 members of the building community (Appendix F). Also reviewed were studies performed by the Institute in

its contract work on the BEPS program. From this analysis the preliminary findings were refined and supporting arguments prepared. The arguments consisted of summaries of the major points made in the documents reviewed including quotations of particularly pertinent points. The intention was to reflect as many points of view as possible while highlighting the common positions; however, no representation is made that this analysis reflects all of the positions taken on the proposed standards or all of the comments that could be potentially made. Accordingly, this presentation in no way supersedes the response to the NOPR of any other group, rather it is representative of the collective views of the participants.

Based on the findings and their substantiation, general conclusions were developed and presented to the BEPS Advisory Panel at a meeting on April 17. The Panel reviewed the conclusions and then proposed recommendations regarding the future direction of the BEPS program. These recommendations were provided to the Board's Energy Affairs Subcommittee for its consideration on April 18, 1980. At that time the Subcommittee formulated its recommendations, which, in turn, along with the general conclusions, findings and substantiation, were presented to the Board of Directors for its consideration and action on April 25, 1980. At that meeting the Board adopted this report as the Institute's official position on the proposed performance standards.

FINDINGS AND DISCUSSION

Finding:

The validity and appropriateness of the proposed Design Energy Budgets (DEB's) for commercial and multi-family residential buildings have not been established in a scientific and readily demonstrable manner. The credibility of these numbers is also weakened by perceived shortcomings in the original research and in the numbers themselves, and by the potential new data, made available by on-going research, may change the numbers in the final rule.

Discussion:

As stated in the Notice of Proposed Rulemaking (NOPR), DOE's selection of the proposed Design Energy Budgets (DEB's) for commercial and multi-family residential buildings was not a result of any one analysis, but an informed judgment based on all available information. As a result it is difficult, if not impossible, to make a realistic assessment of the validity of the proposed budgets. The National Bureau of Standards in its preliminary comments concluded that "the NOPR and ten technical support documents do not provide building researchers with sufficient information, such as separated heating and cooling energy requirements, to check DOE's proposed energy budgets." (See Summary of NBS General Recommendations and Comments dated January 31, 1980.)

Many organizations argue that the proposed budget numbers must be validated by comparisons against actual metered energy consumption data of operating buildings. For example, the American Consulting Engineers Council (ACEC) stresses that while the estimated design energy requirements by building type obtained from the redesign effort may be accurate, a determination in this regard requires the examination of actual consumption data. Since none of the Phase II redesigned buildings were constructed, actual data is not available. ACEC contends that the computer simulations of the redesigns bear little or no relationship to actual performance levels. This contention is supported in some measure by the comparison of the estimated energy use of the redesigned buildings as calculated by the ORNL commercial energy model to the estimates of design energy requirements as calculated by the AXCESS model used in the Phase II analysis (see Table 5-12, page 5-24, of TSD No. 8, Economic Analysis). The estimated use computed by the ORNL model exceeded the estimated design energy requirements computed on AXCESS by 37 percent in the case of hotels, by 55 percent for health facilities, by 88 percent for schools and by 121 percent for offices.

Notwithstanding the fact that the proposed standards are intended to be design, not consumption, standards, it does not appear practicable to totally ignore a building's actual energy consumption. As indicated above, many see the need for actual data in order to validate proposed energy budgets. Others consider it essential that there be some definable relationship between design versus actual consumption in order to: avoid professional liability problems; demonstrate to clients and owners the economic merits of paying increased design and construction costs for energy conservation features; and establish a basis for future modifications of the budget levels.

Absent the ability to verify the proposed DEB's by comparison with actual data, organizations have attempted to look at the numbers themselves to determine if they appeared reasonable and appropriate. One apparent criteria used for a test of reasonableness is the ability to comply with the levels. ACEC, for example, stated its belief that it is possible to comply with the DEB's and conceivable that engineers and architects could begin designing to meet the requirements of BEPS today. However, they also indicated that such design efforts would be costly to the point where it might affect an owner's decision to build at all. On the other hand, the Commissioner of the Department of Buildings in New York City indicated that many typical design and occupancy considerations in the design and construction of buildings in New York City and in other dense urban areas would pose a dilemma in application of the proposed standard, to the point, in many cases, of totally prohibiting construction.

DOE's own panel of Federal Agency Construction Experts, after reviewing the 50th percentile redesign levels, concluded that the 50th percentile level could be met, "although at a possible undesirable increase in first cost and design time." They felt that these were the most stringent levels the industry was capable of meeting (see pages 3-6 of TSD No. 3, Energy Budget Levels Selection). Notwithstanding the judgment of the Panel, DOE has set the budget level for commercial office buildings at the more stringent 30th percentile level.

Other representative and pertinent comments regarding the validity or appropriateness of the DEB's are summarized below:

- Due to the criticality of selecting the right degree day base, the energy budget levels for ocean-tempered climate zones are relatively lax in relation to interior continental zones. (NBS)
- Because of the use of energy at a large, central, tertiary hospital is so different than the use at a small, satellite hospital, a single budget number for the hospital category is not realistic. (NSPE)
- The categories of single family attached and multi-family low rise residential buildings are defined in such a way that a typical two-story suburban condominium can quite readily fall in either category, depending on corridor or entrance configurations. Yet the energy budgets for these two categories vary by more than 100 percent in many cases. Thus, a difference is too large to be accounted for by the exclusion of domestic hot water from the single family number.

- The energy budget levels for all-electric office buildings are in many cases 50 percent below the present level of energy consumed by buildings that have been extensively redesigned and retrofitted with energy conservation measures. They are also substantially below the present level of energy consumed in some Federal office buildings with the most advanced energy design. (Kansas Gas and Electric Company)

Some of the basic methods employed in the original research effort are also considered to undermine the validity of the proposed budget levels. ACEC stated that:

> "During the Phase II analysis, a regression technique was used to test the variables which seemed to influence a building's energy consumption characteristics. In order to use the information resulting from the regression analysis, estimates were made to determine the average use of certain characteristics for each building type. This estimation technique compromises the original findings and seriously dilutes cases of wide variation from what is considered the norm. It is our opinion that these averages do not represent the 'real world' situation. It would be extremely valuable to learn of the boundary conditions revealed by the regression analysis to determine how wide the variations are for each building type."

In this regression analysis, in order to make estimates of building characteristics for the various building types, a mean or average was used for each building type. Using such a technique, any cases of great variation or discrepancy in building type are diluted into a common middle ground. By contrast, using a median technique provides a truer picture of the middle range. It would be helpful to understand whether in using the mean method, any consideration was given to possible variations outside the norm, and to what degree is it possible that these averages do not represent the "real world." On a technical basis, it is not clear that the statistical basis for determining the significance of the regression analysis was determined to be valid. The method used to test validity, R^2 statistic, is a relative one which only suggests the degree to which a result is meaningful. Used alone it may not provide a clear enough measure to allow meaningful conclusions. Some further discussion may be useful to clarify the ways in which this measure was adopted since it appears to be the only test used, and further, how the very low values ($R^2 = .51$ or lower) were dealt with since they suggest unreliable results.

Another major concern with the original research is the fact that process energy has been excluded from consideration in setting energy budget levels even though it is recognized that process loads have a major impact on total building energy use. In its testimony, the Baltimore Gas & Electric Company sets forth the example of process energy in supermarkets as follows:

> "The vary fact that process energy has not been studied causes questions to be raised about Design Energy Budget Levels for almost all non-residential construction. For example, supermarkets in Central Maryland recapture waste heat from the

> compressors of their frozen food and refrigeration equipment to heat the building. It appears to us that Design Energy Budget Levels in Table I-3 under "Stores" (1) do not allow any credit for this recaptured heat and (2) do not take into account the intensive process requirements needed to keep fool at refrigerated temperatures in order to prevent spoilage in supermarkets. Refrigeration accounts for almost half the MBTUs per square foot per year that a grocery store consumes. Design Energy Budget Levels give no credit for this reclaimed process energy, while, in fact, this is a source of energy used to heat the building eight months of the year. This example shows why we feel it is absolutely essential that reclaimed processing energy be included in the Design Energy Budget Level."

Other comments point out that the research did not adequately take into account the dehumidifying loads encountered in some southern states, the existence of micro-climates in many SMSA's and the fact that some of the Phase II redesigns were found not to conform to ventilation requirements.

A final major concern expressed in many comments was the fact that extensive additional research which may have major impacts on the proposed energy budget levels is currently underway. There is a high degree of expectation that data generated as a result of this research may change the budget levels. Therefore, strong arguments are made for making these new data available for public review prior to finalizing the rules.

Finding:

The Design Energy Budgets (DEB's) for commercial and multi-family residential buildings are based on an analysis of a small and potentially non-representative sample of buildings.

Discussion:

In its testimony at the Department of Energy hearings on the BEPS rulemaking process, the National Society of Professional Engineers (NSPE) stated that "the basic research data and its extrapolation into Energy Budget Levels is considered questionable as a basis for a national standard." The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) went on to amplify this comment as follows:

> "The number of buildings involved in the redesign effort (168) covering seven climatic zones subjected to an energy analysis computer program AXCESS (questioned by the Technical Advisory Group), extrapolated to apply to 16 building categories in 78 SMSA's is of questionable validity.---the fact that such a large number of energy budget figures evolved from such a relatively small sampling covering a diverse range of climatic conditions leaves ample room to raise questions as to the results."

The concerns expressed in this statement were reflected in the comments of many other organizations responding to the NOPR. ASHRAE stated,

> ". . .the proposed BEPS budgets were derived in large part from specific analysis of a relatively small building sample. For example, in the commercial category, there were 125 buildings from 37 Standard Metropolitan Statistical Areas and all were designed by architects and engineers."

Although ASHRAE understands the need for the use of sampling techniques, it also sees the need to review and re-evaluate the proposed DEB's, giving particular attention to the adequacy of:

(a) "The building classification scheme (due to the wide range of functions within specified building types).

(b) "The effects of building size and shape.

(c) "The limited number of locations for which climatic data is specified and the selection of alternatives based purely on degree days (for example, there appear to be discrepancies in the levels of stringency in different climatic zones).

(d) "The effects of special operating conditions within a single classification.

(e) "The manner in which the weighting factors were developed and applied.

(f) "The exclusion from the sample of buildings not designed by architects and engineers."

The American Consulting Engineers Council (ACEC) commented in a similar vein by stating that they were

> ". . .extremely skeptical of the statistical base from which the energy budgets were derived. The original 1,661 buildings surveyed under Phase I was, in our opinion, a very good sample. However, the Phase II research and the Phase II redesigns were conducted on a much smaller sample of 168 buildings. We understand that the lack of adequate funds prevented study of the entire Phase I sample. Yet, we believe it to be imprudent to attempt to base a national energy standard on so limited a research study."

ACEC amplified its concerns by indicating that it was

> ". . .aware that the original research sample was not intended to be used to establish energy budget levels. The original intent of data collected by the American Institute of Architects/Research Corporation was to offer a 'snapshot' of design and construction practice in 1975-76. This represents a serious statistical problem because the original sample was not selected to reflect regional variations in design practice, climate conditions, available materials, available services, etc. Nevertheless, the DOE Budget Levels were based on the AIA/RC data. We are concerned that the assigned Energy Budget Levels may not be representative of the building types and climates studied. Further research, based upon metered data of existing buildings, is in order to verify the established figures."

The National Institute of Building Sciences (NIBS), in its own review of the Statistical Analysis technical support document, questions the statistical representation of the Phase I and Phase II research, particularly with respect to whether or not the 168 buildings selected in Phase II are a sufficient sample size for analysis.

When broken down by building type and energy consumption characteristics, there remains only one or two observations per cell. A small sample size such as this not only inhibits the range, and hence representation, of buildings to be tested, but also limits the degree of stratification possible for building types. For example, as stated in the technical support document: "The size of the sample is too small to allow for further stratification by building size." Such stratification would provide for greater detail and reliability in the analysis.

A basic question, therefore, is whether the small number of "observations" made causes a bias in the sample by giving greater attention to and relying most heavily upon one or two buildings as being representative of a larger, more diverse universe. It has been suggested, for example, that the sample may be skewed towards larger buildings while at the same time not really being representative of either small, medium or large buildings. The issue of representativeness also applies to the geographic distribution of the building types which likewise was based on only a few observations.

Further questions arise, in part from the basic consideration of sample size, relating to various statistical techniques reported in the analysis. One such question has to do with the lack of an estimate of the accuracy or representativeness of the sample. As the technical support document indicates, "No numeric accuracy objective is set because of the severe limitations which were imposed on sample size." It would be helpful to the analysis to have some assessment made which identifies the accuracy of the methodology employed.

Similar concerns appear to be held by the National Bureau of Standards as reflected by its recommendation that DOE "drop claims of statistically based results in favor of 'professional judgment and analysis' for interim approach, then consider proceeding to develop and evaluate feasibility of minimum life cycle cost approach for commercial buildings."

Another question involves the degree to which the non-response in the Phase I survey, amounting to almost 50 percent of those sampled, affects the results of the Phase II effort, since the two are so closely interrelated. Here, too, the National Bureau of Standards is concerned in that it recommends

> ". . .for commercial buildings, consider conducting follow-up studies to remove potential bias from Phase I and Phase II sample selection response (e.g., non-respondent effects) and to analyze available data to validate or make better assumptions than 'normal' distribution."

ACEC expressed its concerns by stating

> "While it is difficult to assume that the information overlooked, as the result of the poor response, would have significantly altered the techniques employed during the statistical analysis, it is probable that such information would have impacted the resulting Energy Budget Levels. In other words, we are not confident in the least that the results presented by the strenuous research effort reflect the proper profile of energy usage in our nation's buildings. The sample size was severely narrow. We could be more positive about the research findings if a broader sample were studied and an assessment made to identify the accuracy of the methodology employed."

In comments submitted by letter to DOE, the Commissioner, Department of Public Buildings of New York City, made several observations regarding the non-representative nature of the Phase II sample as follows:

"In reviewing the extensive material that was distributed together with the proposed rules, it appears that the buildings studied country-wide in Phase 2 of your research are unrepresentative of most buildings designed and constructed in New York City. This is regrettable, since the inclusion of such buildings would have highlighted many significant factors that would have obviously been considered by your consultants and colleagues in their preparation of the numerous technical documents, the omission of which represent serious and significant shortcomings in the proposed standards.

"As was indicated above, the design of 'BEPS' was not geared to the range of building types in dense urban areas where orientation, flexibility and renewable energy sources are not realistic. Since this will represent a large percentage of total construction in the country, further analysis of this range of buildings and site situations should be made."

Finding:

The life cycle cost analysis used to derive the single family residential Design Energy Budgets (DEB's) is deficient and has resulted in inequitable and otherwise unreasonable budget levels.

Discussion:

Development of the residential Design Energy Budgets (DEB's) on the basis of a life cycle cost (LCC) analysis required a two-step approach. The first step was to select a set of measures that were cost effective for two prototype houses (one single family detached and one single family attached) in ten locations using assumed prices for fuel and materials. Based on these "optimal cases" the design energy consumption was calculated (estimated) and expressed in terms of design energy budgets (expressed in MBTU/sq. ft./year).

The second step involved expanding the results of the initial analysis (10 SMSA's x 2 prototypes) to the universe of single family residential units (attached and detached) located in 68 other SMSA's using regression analyses.

While this methodology may be conceptually sound, a number of variables which significantly influence residential energy consumption were not considered in the analysis. The degree to which these variables have created inequities and unreasonable DEB's is discussed below.

- A life cycle of thirty years is inappropriate. While this is based on the assumption that a house may remain in the nation's stock for at least thirty years, it is not possible to assure a homeowner that his heating equipment, insulation, or other energy conservation measures will last that long.
- Any attempt to project costs of fuel or materials thirty years into the future seems particularly difficult in light of recent escalations in fuel prices. It is argued by many home builders that the additional first costs associated with the current BEPS standards are too high, that the homeowner will not be able to recover his investment when selling his house. At the other extreme, it is argued that the low fuel prices used for the LCC analysis procluded analysis of more sophisticated higher efficiency equipment and active solar heating systems, which even at today's prices may be cost effective.

Regardless of the assumed life cycle or the perceived hardships associated with this approach, real inequities exist in several areas:

- The regression analyses were performed based on DEB's for one prototype in each of 10 specific SMSA's. The LCC analysis for each location identified the highest cost effective levels of energy conservation measures for that location's climate and equipment operating profile. Using the ten actual points, a regression "curve" was developed based only on variations in the number of heating and cooling degree days. This approach incorrectly assumed that similar levels of conservation measures would achieve directly proportional energy savings in all locations. Conversely, it also assumed that a given budget could be met with proportional levels of conservation measures in all locations. However, not all locations fall directly on the curve. Simply stated, in order to meet the budget, any specific location above the line will require more conservation measures than intended, while points below the line will meet the budgets with less than the intended levels of conservation measures. The consequence of this is that the cost effectiveness of the proposed DEB's is not constant.

- Actual regional and local variations in fuel prices due to utility rate structures, seasonal peak loading, and availability of particular fuels, alone, or in combination with variations in the cost of conservation measures, increase the possible variation in the payback period. The National Association of Home Builders (NAHB) has analyzed the additional conservation measures that would be required to bring a house built in 1978 into compliance with BEPS. The payback periods (the additional dollar cost to meet BEPS divided by the dollars of energy saved in the first year assuming no increase in prices) vary from zero to twenty years.

- Variations in weather conditions exist among the 78 SMSA's included in the NOPR that may significantly influence the design energy consumption of a residential building. Consideration of the influence of such climatic variables as average dew point (used in calculating the dehumidification portion of cooling loads), wind speed (relevant to determining the rate of infiltration and heat loss through the building envelope), cloud cover and ground reflectance (pertinent to calculating solar heat gain) and ground temperature (used in calculating heat loss through the foundation) contributes to making it virtually impossible to meet the required DEB's in some locations (San Francisco and Seattle), while in other locations (Tampa, Miami and Los Angeles), it contributes to making it possible to easily satisfy the budgets. This situation occurs because the regression analysis used to determine the DEB's relies entirely on variations in the number of heating and cooling degree days. Calculation of heating and cooling degree days is basically an "accounting technique" that considers only mean daily temperatures regardless of the number of hours that the heating and air conditioning systems are actually operating. However, the Standard Evaluation Technique (SET), used to calculate design energy consumption, takes into consideration the other climatic variables described above.

- Another deficiency of the regression analysis with regard to heating and cooling degree day calculations for residential buildings is the fact that the assumptions concerning a residence's operation were based on the analysis of commercial buildings. In these buildings simultaneous heating and cooling is often required when the outside temperature is between 50°F and 60°F whereas this is not the case with residences. Accordingly, in moderate climates, for example, in San Francisco (mean temperature of 57°F), it was assumed that periods of heating and cooling would be required when, in fact, neither is necessary. As a result, to meet the budget in San Francisco, a house would need R-38 in the ceiling, R-19 in the walls, and triple glazing. However, the SET, which calculates the design energy consumption based on actual operating conditions, projects consumption at levels so low that these measures would never be cost effective. These anomalies create situations which are obviously contrary to the Department of Energy's intentions of requiring cost effective levels of conservation measures.

- Data provided by NAHB indicates that 33 percent of all new residences constructed in 1978 had no central air conditioning. The assumption in the development of the residential DEB's that all houses are centrally air conditioned creates an inequity for these households (e.g., requiring levels of conservation investment which will not be cost effective). Simply stated, if there is no expenditure for fuel required for air conditioning, there can be no "savings" against which investment in conservation is amortized. Even those houses which are centrally air conditioned may be required to install conservation measures which will not be cost effective. This may occur for a variety of reasons including:

  -- local variations in summer and winter utility rates which were not considered in the LCC analysis; and

  -- the use of annual (as opposed to seasonal or "design day") analysis is not valid considering the real differences in actual consumption of two locations, one temperate and one extreme, which may have the same mean temperature or average number of heating and cooling degree days.

Derivation of the DEB's should consider at least as many climate variables as the SET will evaluate in calculating consumption.

In addition to the economic and climatic deficiencies discussed above, there are a number of variations in the design and construction of the housing stock that are ignored in the process of setting the DEB's. Each has a potential influence on a design's ability to meet the specified budget and will influence the cost effectiveness (i.e., the payback) of the conservation measures that will be required.

A number of organizations and individuals have cited specific examples of inequitable or unreasonable budgets. The purpose of this discussion is to outline some of the areas which may have caused these anomalies. The Institute fully understands the difficulty of conducting exhaustive sensitivity analysis of each specific parameter but cannot ignore the need for a re-evaluation of the process by which the DEB's were derived.

- Regarding the prototypical houses used in the regression analysis, NAHB has published data for 1977 and 1978 indicating that new houses are, on the average, larger than the DOE prototype for single family detached houses. In conjunction with this data, NAHB has conducted tests comparing the design consumption of two houses (similar in all respects except square footage) with the DEB's specified in the NOPR for 12 locations. The results indicate a 10 percent variation in the levels of conservation required to meet the DEB's. This indicates that the relationship of BTU consumption to square footage is not linear as assumed in the BEPS.

- The configuration of the house (e.g., the wall area to floor area ratio), the height of the ceilings, the type of substructure (e.g., crawlspace, slab on grade or basement), the orientation and the infiltration rates were "assumed" for the derivation of the DEB's. It has been estimated that calculated consumption based on actual design parameters may vary as much as 20 percent from the DEB's, requiring levels of conservation investment well above or below those which the Department deemed cost effective.

- The analysis of single family attached houses, particularly town houses, is based on a single prototype. Research conducted by NAHB indicates that in Denver, certain units in a series of town houses could not be designed to meet the budget using any known construction techniques including R-38 in the ceiling, R-24 in the walls, and triple glazing. In yet another case it was found that by rotating a row of town houses as little as 10° off the optimal orientation axis they could not be designed to meet the budget. Their extreme sensitivity to orientation (in conjunction with obvious siting limitations) demands further analysis. At least two additional prototypes are needed (east and west end units), in addition to further consideration of east-west facing houses (north-south street axis).

- One additional aspect, infiltration, is handled in a particularly arbitrary manner in an attempt to avoid the issue of indoor air pollution. Although a rate of .6 air changes per hour is assumed, the Department of Energy states: (SET TSD)

  ". . .infiltration has not been satisfactorily simulated by DOE-2 or any other program to date. Therefore, the methods prescribed are at best subjective, but represent the state of the art, and the limited data collected to date."

  The selection of a fixed air change rate, as a function of floor area, does not consider variations in the ratio of wall surface area to enclosed space or the quality of construction. While these variables

> may be difficult to quantify, some incentive should be given for optimizing these parameters. Several other methods including the "crack method" consider such influences as wind speed, size, number and location of doors and windows, and the relationship of indoor to outdoor temperatures.

For the most part, consumer groups have evaluated the residential DEB's from the standpoint of their impact on the less afluent homeowner. There is a recurring concern that the proposed DEB's will not make a significant enough difference in consumption to justify the additional cost, both to the homeowner and the nation. To quote the testimony of Rural America,

> "Standards should be set high enough to maximize the savings to homeowners but not so high that it raises the cost of the house to where low-income people cannot qualify for the subsidized housing programs."

The National Low-Income Housing Coalition suggests that "the answer to the dilemma of how to deal with the [first] cost impact of rigorous BEPS would seem to lie in exploring alternative financing devices: perhaps expanded use of graduated payment mortgages, or front-end subsidies." These alternatives would lessen the burden created by the lack of positive net savings in the early years. Under LCC analysis (based on continually escalating fuel prices) what occurs in the early years is that the annualized cost of the additional conservation measures is greater than the actual savings in energy, thereby making many potential homeowners ineligible for loans.

Among specific comments concerning the assumptions made with regard to the DEB's, Rural America states,

> "As the standard is now proposed, far from being penalized for designing large residences, it is easier for designers to build a large house to meet a certain per square foot energy budget than a small house. The reason for this is that small houses have more surface area per square foot of floor area than large houses. If we built a large and a small house insulated to the same specifications, the small house would consume less total energy than the large house, but per square foot of living area would consume more energy than the large house."

It is also felt that since insulation levels were only analyzed up to R-38 in the ceiling and R-28 in the walls, the effect of the standards would be to require identical insulation levels over most of the country. Further, the point is made that in contrast to the assumption that all houses are air conditioned, "DOE should put disincentives in the BEPS to discourage it." Also, it is recommended that DOE should accelerate their mobile home research in order to include them in the final rule.

Finally, Rural America cautions,

> "Since low-income housing includes very few frills, it is likely that the increased building cost due to BEPS for low-income housing is likely to be slightly higher, perhaps 5 percent to 7 percent. For those subsidized housing programs (federal, state and local) which do not include utility payments, BEPS will reduce the number of units of housing which can be built under current appropriation levels. DOE should inform those agencies with subsidized housing programs of this effect and request them to ask for higher budget levels to compensate for this."

Finding:

Expressing the design energy budgets (DEB's) for domestic hot water usage in single family residences in terms of BTUs per housing unit, without regard for household size, is inappropriate and should be re-evaluated. Further, the specific assumptions made in developing the budgets concerning water usage and temperature differential, the outlet temperature less the inlet temperature, are also incorrect and warrant further research. Revising either the unit of measure or the assumptions would change the hot water budgets.

Discussion:

While it is understandable that predicting the number of eventual occupants of a house may preclude basing the budgets on consumption per occupant, it would seem more reasonable to attempt to vary estimates of consumption by the number of bedrooms, water consuming appliances, fixture units, bathrooms, or at worst, square footage. This would more accurately reflect actual usage.

No explanation is given for the selection of the 64.3 gallons per day consumption assumed in the analysis. This same level was used in the Department of Energy's test procedures for water heaters to determine water heater efficiency factors. According to the Gas Appliance Manufacturers Association, the test procedure using this fixed number unfairly rates the efficiency of larger capacity heaters (which are sized for higher consumption). This creates an inequity in attempting to meet the DEB's. If the actual energy factor (efficiency ratio) for a larger water heater is too low (because of questionable test procedures), the budget can be met by substituting an smaller, inadequately sized water heater.

The energy factors of water heaters have not yet been formally established. A new set of test procedures is expected to be published in early May, 1980. However, when and if minimum efficiency standards for hot water heaters become effective, all the parameters of the DHW budget calculation may effectively become "fixed," rendering calculation of the DEB's unnecessary and raising the question of whether or not hot water budgets are meaningful.

Other issues which have been raised concern the fixed temperature differential, ΔT, of $90^{\circ}F$. This approach assumes that colder climates use proportionally cooler water than warmer climates, as ΔT is a function of ground temperature at the inlet. Researchers at the Applied Science and Engineering Laboratory in Denver have found that the opposite is in fact the case:

> "Hot water heaters in Seattle homes were maintained in considerably higher levels than were those in Phoenix. Certainly part of the reason might be related to the cool, damp, relatively sunless winter encountered in that area. Higher illumination and warmer water might tend to compensate for the cooler environment.
>
> "Thus in Seattle the individual is physically more comfortable in a cooler building since he has tended to adapt to cooler environmental temperatures, but emotionally prefers brighter environments and hotter water. By contrast, the Phoenix resident has adapted to warmer temperatures but perfers more subdued light levels and cooler water."[1]

In fixing ΔT at $90^{0}F$, eventual, actual variations in consumption are not addressed. If these variations were considered, a more reasonable assessment of the benefits of solar systems would be evident, particularly in cooler climates.

Another issue associated with a fixed ΔT is that in areas where outlet temperatures are low, actual consumption in gallons of water may be greater. In considering such alternatives as fixing the tank temperature, this must not be ignored.

Finally, in discussing the wisdom of including domestic hot water (DHW) DEB's in the standards, the question arises of whether or not trade-offs in envelope thermal integrity are appropriate or justified. From an engineering standpoint, the two systems are not interactive. Aside from a minimal amount of heat loss through the surface of the heater (which is often given up into an unconditation space), the energy expended to heat water is not related to the energy expended for space heating and cooling.

The stated intent of this approach is to encourage the use of solar DHW systems. If this is the case, then the bases for calculation must consider the technical issues outlined above, to ensure that if credits are given they are equitable with regard to climate, house size, and projected hot water consumption.

1/ "The Two-Legged Thermostat"; Jay L. McGrew, Progressive Architecture, April, 1980, page 147.

Finding:

The proposed Standard Evaluation Technique (SET) intends to use a computer simulation method, DOE-2, as the principal technique for calculating the design energy requirements of building designs. DOE-2 is presently inadequate and will remain so until its capabilities are expanded and it is validated.

Discussion:

The Standard Evaluation Technique (SET) and the various computer programs proposed as key calculation methods are the subject of numerous comments pointing to potential inadequacies and technical deficiencies. These problems included such items as: suspected bugs and minor flaws in the computer programs and their subrountines; lack of capabilities to simulate or take into account important "real world" situations and considerations; and major limitations which are common in large scale, complex computer simulation models.

Perhaps a more significant problem is the fact that the DOE-2 computer program does not currently have the capability to simulate most of the heating and air-conditioning systems in common use today. While it is capable of simulating central systems, it cannot handle the unitary commercial and residential systems which make up the bulk of the units sold in today's market. Nor can it handle room-by-room controlled electric baseboard heating. In the NOPR and technical support document, DOE itself points up the need to expand DOE-2's capabilities so as to be more in line with current market conditions. It is also significant to note that attempts to apply DOE-2 to twenty of the Phase II buildings demonstrated the program's inability to simulate the systems in twelve of them. Also, since the DOE-2 simulation model is highly complex, 5 subprograms and some 250 subroutines, and correspondingly difficult to change, it is recognized and generally accepted that the program's simulation capabilities will lag the state-of-the-art in systems design by at least two years.

A second very significant problem is the potential with DOE-2 for user "errors" or differences of up to 25-30 percent in the calculation of design energy consumption. Notwithstanding the number of fixed parameters required by SET, there are still many inputs that require judgment and permit a wide range of choice on the part of the user. The American Society of Heating, Refrigeration and Air-Conditioning Engineers points out that

> " . . . there are a sufficiently large number of decision points in the analysis procedure that two competent and conscientious professionals attempting to model a system which does not precisely fit the standard systems covered by DOE-2 could arrive at significantly different answers. Knowledgeable, but unscrupulous individuals could manipulate this complex procedure to arrive at almost any desired answer."

It is this potential room for manipulation, a situation common to most large scale, computer simulation models, that poses a high risk in relying on DOE-2 as a primary compliance determination method.

Other problems, of less significance, but that still detract from the willingness of the building community to accept DOE-2 were identified by the Log Homes Council. These involved the exclusion from consideration of such things as:

- "Long term effects of site conditions on the thermal envelope; for example, the detrimental effects of moisture, dust and compaction on the R- value of insulation materials.
- "The effect of installation defects on the performance of the thermal envelope or the efficiency of the HVAC systems; for example, insulation gaps or compression of insulation by conduit, pipes, etc.
- "The heat flow of non-homogeneous building constructions or materials, such as insulated cavities interupted by framing members or hollow masonry units with voids and solid sections."

The Council points out that

> "these items will have a significant effect on the discrepancy between Design Energy Consumption and Actual Energy Consumption. In addition, an improper or lack of consideration of these items may render the life-cycle cost comparisons of certain building constructions to be totally inaccurate and useless. Continued research must be conducted in these areas in order to improve the accurace of the Standard Evaluation Technique."

Another shortcoming, as identified by the Insulation Contractors Association of America, are the apparent unrepresentative assumptions regarding the complex analysis and treatment of basement areas and unventilated crawl spaces with and without HVAC equipment and distribution systems. The Association points out that the measured data in the literature indicate that these areas, particularly basements, account for significant portions of the heating energy consumed in a home. The percentage becomes even more significant when dealing with sloped sites with partial or full walkout basements.

The Association also believes that the home design used as a model in all the analyses for single family detached dwellings is wholly unrepresentative of new homes being built today, particularly as regards the average size of approximately 1100 square feet. Since it has been their experience that energy consumption for heating and cooling is not proportional to the square footage of living area, they question the appropriateness of budgets and consumption calculations for larger homes.

Still another area of concern expressed by both the NAHB and the Insultation Contractors Association is the assumption incorporated in the simulation model that all homes in all parts of the country are centrally air conditioned. Absent any mechanisms for making adjustments when a house is not to be air conditioned, this assumption represents a significant penalty on approximately one-third of the homes being constructed today and on perhaps an even larger share in the future as the "housing affordability" problem reaches crises proportions. The Insulation Contractors Association also find it difficult to accept the validity of estimates of heating consumption and of air conditioning usage on the degree day bases of 60° F and 50° F, respectively, particularly since cooling degree days have not proven to correlate with air conditioning energy usage.

DOE has acknowledged these and other problems and shortcomings with DOE-2 and indicates that new capabilities are being worked on and refinements and corrections are being made to existing programs, all of which are planned to be ready and available by the August 1980 rule publishing date. However, the size and complexity of DOE-2 and the magnitude of changes needed, combined with the fact that the model has been evolving since the mid 1960's, does not lend much credence to the claimed August completion date.

Finding:

Because of the complexity of the SET's computer methods for calculating design energy consumption, the majority of design firms and builders lack both the expertise and the financial resources to use them. More simplified methods of determining compliance with the BEPS will be required.

Discussion:

> "The complexity of the analysis and computation procedures is overwhelming. When only one in five existing design firms has any computer capability, it concerns us greatly that a computerized analysis is required by the present Standard Evaluation Technique." (Hugh D. McMillian, Jr., President of ASHRAE)

> "We have spent hundreds of hours on the computer analyzing the Standard Evaluation Technique (SET) and can conclude that is is impractical for residential and commercial construction. This SET is not only beyond the capability of builders and building officials, but also most of the design professionals in this country. Our concern, therefore, is not only that builders will have to pay a design professional to determine whether his buildings comply with BEPS but also whether he can find such assistance." (Merrill Butler, President of the National Association of Home Builders)

The foregoing statements reflect the prevailing views of design professionals and builders concerning their ability to use DOE-2 and the other computer programs required by the SET. They lack the computer capability to use this evaluation technique to calculate design energy consumption.

Most design firms and builders also have a limited number of employees from which to draw the technical skills and manpower required to use the SET. For example, the American Consulting Engineers Council (ACEC), a national federation representing 3,600 independent consulting engineering firms, found that 63 percent of its members have ten or fewer employees.

According to the most recent National Association of Home Builders (NAHB) "Profile of the Builder" survey, the average number of non-construction employees for single family homebuilders has declined from ten in 1969 to six in 1976. For multi-family homebuilders, over the same time period, the decline has been from 16 to 11. These numbers include all executives, professionals, technical and general office employees. This same survey indicates that while builders' use of architects and engineers has increased from roughly 40 percent of all firms in 1969 to 63 percent in 1976, only 18 percent of all firms maintained architects on their staff and only 7 percent had engineers.

ASHRAE estimates that 40 to 80 hours will be required to train design professionals to use DOE-2, and upward of 80 person-hours will be required to complete the initial analysis of a commercial or multi-family residential building and to prepare input for the first computer run. ACEC projects that preparation time will range from 50 to 300 hours per building, depending upon its type, complexity, and location. At $20 per hour in the extreme case, additional labor costs alone could run as high as $6,000. Person-hours included in additional runs will, of course, depend on the extent and nature of design changes. Due to limited human resources, most design firms and builders will be compelled to engage consultants and to incur additional out-of-pocket costs.

The BEPS will have a significant impact on the cost of construction. As indicated in the technical support documents, DOE has estimated that the BEPS will add from $0.75 to $1 per square foot to the price of a new residence. But this estimate does not include added costs for design, permits, construction delays, inspection and overhead. NAHB calculates that consideration of these additional factors will add more than twice the DOE estimate to the price of a typical new home.

Consider the projected impact of the SET on design costs: Based on information made available from consulting engineers throughout the country, ACEC estimates that design costs will increase from 10 percent to 40 percent. ASHRAE indicates that while it is estimated to cost an architect or engineer $300 to $500 to determine the compliance of a 10,000 square foot building with a subsystem-oriented performance standard, e.g., ASHRAE Standard 90-75, determining the same building's compliance with a whole building performance standard, which requires a computer analysis, could cost from $2,000 to $3,000. Moreover, a complete energy analysis - including early estimates in the design phase, an analysis of system options, and a determination of BEPS compliance - is expected to cost $10,000.

Clearly, these human resource and cost requirements will have their most significant effect on small design firms and small homebuilders, which comprise the bulk of the building industry in terms of numbers of firms. The impact of these extra costs will be greatest on smaller projects, since energy analysis costs are not directly proportional to building size. The problem is especially acute for low income families; higher initial housing costs - exacerbated by high interest rates - will price many low and moderate income families out of the housing market.

Use of the SET will also have a significant impact on larger projects. GSA, based on its experience with 15 major Federal office buildings, estimates a cost of $3,000 to $5,000 to verify compliance with its building line energy budget requirements of 55,000 BTU/sq. ft./year and source energy budgets of 100,000 BTU/sq. ft./year. The cost of optimizing a building design from an energy consumption point of view can range up to $20,000, the actual expense being a function of how well acquainted design professionals are with energy analysis methods and with integrating these methods into the overall design process for large buildings. However, GSA indicates that it has not experienced an appreciable impact on design fees for large projects. It would appear, however, that a significant impact will occur on smaller projects to the extent of requiring an adjustment in the current statutory goverment-wide ceiling limitation on the design fees for Federal projects: 6 percent of the estimated construction cost.

All of the above represents the practical burdens that accrue with the use of computer evaluation techniques. There is also a fundamental ideological objection to exclusive reliance on sophisticated compliance procedures such as the SET. One of the findings of Congress in the passage of P.L. 94-385 is that the BEPS program should be implemented through existing state and local code compliance mechanisms "with a minimum of federal interference in state and local transactions..." (P.L. 94-385, Section 302(a)(4)). Complicated computer methods for calculating design energy consumption, will inevitably increase the level of Federal intervention. Federal technical and financial assistance will be escalated; the need for Federal monitoring of state and local implementation efforts will have to be increased to assure adequate compliance.

In summation, most design firms and builders do not have the requisite resources to accommodate the complexity of the SET's computer method of calculating design energy consumption. Practical and ideological factors point toward the need for simplified evaluation tools to render a compliance analysis and determination. These tools should include subsystem and component performance standards similar to ASHRAE Standard 90-75; prescriptive standards and manuals of accepted practice; and simplified calculation procedures. In this way, these simplified alternative approaches will make the BEPS program more accessible and acceptable to the building community.

Finding:

The Standard Evaluation Technique (SET), as currently proposed, is not useful during the design of the building tr help designers make more energy-effective decisions. On the contrary, the SET could actually inhibit the achievement of improved energy performance in new buildings.

Discussion:

The key elements of the SET as defined in the NOPR and the technical support documents include:

1. An energy consumption estimation tool such as DOE-2.
2. A set of fixed parameters required "to assure valid comparison of the Design Energy Requirement (DER) of a building design to the Design Energy Budget (DEB) as specified in the NOPR. These fixed parameters include: weather data; Standard Building Operating Conditions (SBOC); and certain fixed data input design values."
3. Procedures for combining 1 and 2 above to obtain consistent and replicable Design Energy Consumption (DEC) for any particular building.

Achievement of the objectives of, and increased receptivity toward, the BEPS program would be greatly enhanced if some of these SET elements were seen as helpful and useful aids. For example, any techniques and methods proposed for evaluating compliance with a standard should also be useful to designers and builders for analyzing and evaluating alternative design features and equipment choices for achieving that standard. Unfortunately, SET, as currently proposed, is not useful in this regard. For example, the design energy requirement calculation method of SET, DOE-2, requires inputs based on information which is not available until the building design is approximately 75 percent complete and construction drawings are available.[1] As such, DOE-2 cannot be used efficiently to evaluate the energy savings potential of many significant design decisions and equipment choices which must be made during the design development stage or even earlier in the design process during the conceptual and schematic design stages.

1/ For single family dwellings, NAHB believes that the information necessary to use the SET for determining compliance cannot be obtained until the building is completely designed.

ACEC in its testimony makes the following point:

> "It is a fact that the computer serves only to verify that certain decisions with regard to design and certain combinations of materials and equipment are indeed correct. At the point of computer analysis, most design decisions have already been made. If the computer evaluation indicates that an improper decision was made, the act of correcting that decision may have a significant impact on other decisions which have been made during the design process. Altering one decision to satisfy the computer evaluation may require as much additional design time as was required for the original set of design decisions. This is costly to the firm and, ultimately, to the client who must pay for the computer analysis and any additional time required to alter the original design."

Several concerns raised by ASHRAE point to other limitations on the ability of SET to be a useful design analysis technique. These include the fact that some systems currently in use cannot be adequately simulated by the SET nor can innovative approaches which are supposed to be encouraged by the performance approach be analyzed. In addition, the DOE-2 computer program's analysis capability in the equipment and control area is severely limited. Finally, ASHRAE is concerned that the complexity of the computation procedures is so great that practicing professionals cannot possibly adapt them to analyze new systems concepts.

The complexity highlighted by ASHRAE is compounded by the requirement mentioned earlier that many input design parameters be fixed. It is well understood that these parameters must be fixed in order to provide consistency in evaluating building performance. However, many see it as another major detriment to SET's potential usefulness in the design process. They point out that flexibility and interpretation of these types of parameters are essential to obtaining the degree of accuracy in estimates of energy requirements that is absolutely essential during the design effort for the proper selection, sizing, and integration of energy systems.

In addition, the fixing of these design conditions implies that no credit is to be given for their incorporation in a design. This position needs to be justified explicitly on a point-by-point basis if design features are to receive no credit. The need for comparability to the original process used to develop design energy budgets is not a convincing argument. If, in the interest of simplifying the SET certain parameters are fixed, then their negligible effect on annual energy consumption must be substantiated.

Others see this need for fixed parameters as actually inhibiting energy conservation in new buildings. For example, the NAHB sees the minimum air infiltration rate of 0.6 air changes per hour established by the SET as one of several technical difficulties "that make it questionable whether the maximum practicable improvements in energy efficiency will be achieved." The NAHB position is stated as follows:

> "Perhaps the biggest technical deficiency is that the reduction of air infiltration, which is a big energy loser, will be discouraged because the Standard sets a minimum rate of 0.6 air changes per hour.

> "This number is arbitrarily very high and therefore should be lowered to reflect current construction practices. Infiltration reducing construction techniques such as the use of higher quality windows, doors, storm doors, weather stripping, caulking of construction joints, sill sealers and other techniques are very important to reducing the energy consumption of a building and therefore create economic benefits for the homeowner.
>
> "The reduction of air infiltration is a very large factor in reducing energy consumption as compared with increased amounts of insulation and multi-glazed windows and therefore a much more cost effective means of providing added thermal protection.
>
> "To give you an idea of how sensitive the infiltration rate is to the energy consumption of a building, consider a reduction of the infiltration rate by .03 air changes/hour, a mere 5 percent difference from DOE's prescribed value. The reduction of heat loss would be the equivalent of going from R-40 to R-50 insulation in the attic. We must keep in mind that drafty homes are not marketable regardless of how much insulation is installed."

Others point out that a failure to include an allowance for reduced infiltration will seriously hamper the development of such innovative techniques as devices which vary the amount of outdoor air introduced into a building through the air conditioning and heating system by measuring the amount of pollutants in the return air; or equipment which can transfer the heat of exhaust air to the incoming fresh air.

Concerning the infiltration issue, the Log Homes Council pointed out in its draft comments the following:

> "Infiltration represents a significant portion of a building's thermal requirements. A credit or penalty must be given in the Standard Evaluation Technique for buildings with lower or higher infiltration rates. By totally discounting air infiltration the DOE has missed an important opportunity to provide an incentive for the research and development of methods to reduce infiltration losses without affecting interior air quality. Additional research should be conducted in order to develop a more accurate method of calculating heat loss or gain due to infiltration, and credit should be given to buildings with reduced infiltration. This would be in keeping with the letter and intent of The Act which specifies that DOE must develop an Energy Performance Standard 'without specifying the methods, materials or processes used to achieve those goals.'"

NAHB also feels that the disregard for user oriented devices and user controlled energy conserving techniques is another major deficiency that will detract from actual energy conservation. They argue that most builders will not install user operated devices unless given a credit. Therefore, such devices as night-time setback thermostats, lower thermostat setting on water heaters, thermal protection of windows such as shutters, movable insulation, drapes, shades, and any other user devices that will conserve energy will not be available for the homeowner to use, and possible energy savings will be foregone. The same argument applies to the limitation of the DOE-2 residential analysis to a single thermal zone. If no credit is given, builders simply will not incur the extra expense of installing multi-zone equipment thereby eliminating yet another proven mechanism for energy conservation.

DOE-2 also ignores benefits achieved by daylighting, both passive and active solar heating, deadband control and use profiles. Although DOE has stated it will provide procedures for the analysis of these approaches and for the analysis of renewable sources of energy (such as wood-burning stoves and fireplaces, wind generators, photovoltaics, etc.), no one has much confidence that they will be available and verified, prior to promulgation of the final rule.

These types of concerns have led ASHRAE to conclude that,

> "Limitations in the capability of the SET analysis tools, limitations on control and operating strategies, and the unreasonable difficulty of analyzing anything other than the limited number of standard systems presently included in the DOE-2 program combine to produce a procedure much more restrictive to innovative and efficient design solutions than compliance with subsystem-oriented performance standards."

Finding:

The inclusion of the proposed weighting factors in the BEPS will encourage the use of oil and natural gas and discourage the use of electricity. These weighting factors do not differentiate between hydro-electric power and coal-, nuclear-, or oil-generated electrical power. Therefore, they do not meet the requirement of encouraging the use of non-depletable energy sources.

Discussion:

Without exception, the most controversial aspect of the entire NOPR has been the inclusion of weighting factors which account for offsite energy consumption and the value to the Nation of conserving different types of fuel. Whether P.L. 94-385 does or does not provide the authority for including these weighting factors is a matter of interpretation. Lengthy and comprehensive arguments on both sides of the issue have already been submitted in the comments of other organizations. It will serve no useful purpose for NIBS to attempt to summarize these comments nor to add its own interpretation to the interpretations of others. Rather, we have attempted to identify and summarize in a single section the many comments and issues which have a bearing on the pros and cons of using weighting factors at all.

Perhaps the most potentially damaging impact of the inclusion of weighting factors in BEPS was surfaced in the statement of the American Public Power Association (APPA) as follows:

> "The act of favoring one source of fuel over another has already generated much controversy and may imperil the entire program. It would be disheartening to watch a discussion of how best to achieve 'the maximum practical improvements in energy efficiency and increases in the use of nondepletable sources of energy' turn into a debate on the efficiencies of gas furnaces versus electric heat pumps. At worst, the entire BEPS program could be endangered by costly litigation and loss of needed support."

Not only has the incorporation of weighting factors in the proposed rule threatened the entire program, but it has also added a significant amount of complexity to an already complex situation. For example, one opponent of the factors has advanced the argument that since the technical support documents were prepared without any recognition of the weighting factors, they cannot be used in the administrative record to support regulations which do in fact incorporate the proposed weighting factors. A further conclusion is that the technical research must be redone to address the massive effect of the use of weighting factors along with energy budgets.

Aside from these impacts on the BEPS program itself and on the NOPR process, the use of weighting factors is viewed as an inappropriate attempt to develop and implement national policy regarding fuel management. Obviously, the heavy weighting assigned to electricity--2.79 for the residential sector and 3.08 for the commercial sector--has a decided effect of reducing electric energy consumption and encouraging the use of natural gas and oil on the building site. Table 2-9 on page 2-26 of the Economic Analysis indicates that by 1990, two-thirds of direct energy savings resulting from the program will be electricity measured in terms of source energy.

Many are convinced that the replacement of electricity by oil and natural gas actually compromises other national energy conservation efforts, particularly with respect to reducing dependency on imported oil and increasing reliance on coal-fired, hydroelectric, and nuclear electric generation facilities.

Accordingly, it is seen as being in direct conflict with other national energy programs such as the conversion of power plants from oil-fired to coal-fired. In addition, the treatment of hydroelectric generation, or rather its lack of special recognition as a constantly renewable energy source with higher efficiency than oil fired and with minimal adverse environmental impact, is seen as totally irrational.

Others fail to see how replacement of electric heating will ensure that "adequate conservation features" are incorporated in new buildings. In fact, just the opposite effect appears possible. For example, the National Rural Electric Cooperative Association presented the following scenario:

> "Most members or rural electric cooperatives live out beyond the natural gas mains, and do not have access to natural gas. Under the proposed BEPS, however, a builder could build a less thermal efficient (and somewhat less costly) house with the understanding that it was to be heated by fuel oil or propane (a derivative of crude petroleum). Thus it is easy to see why the proposed BEPS (with its weighting factors and life cycle costing approaches) is encouraging the use of imported fuels when the nation's goal is to reduce this consumption. If this fuel is no longer available, the consumer has no choice but to try to heat his home with electricity or solar energy. But this might not be practical since the house is not well insulated, and it will be difficult, if not impossible to bring it up to proper thermal efficiency standards."

The American Public Power Association presented a similar but more extended scenario as to the longer term impact of the weighting factor together with a series of questions, as follows:

> "Buildings built to do one job are almost always called upon to meet different needs of later tenants. The future contains unknown factors that will influence energy use. And, consumers have traditionally had the freedom to change heating fuels, water heaters, doors, floors and windows. What will be the effect of these later changes? By permitting a lower level of energy efficiency in gas and oil heated construction today, DOE will hasten the day when these two depletable fuels are no longer available or economical for space heating. These

> less efficient buildings will not be abandoned; they will be converted to electric heat, which can be generated from oil, gas, coal, hydro, shale, wood, fission or municipal waste. In fact, hopefully, many of our next generation of buildings will be heated by electricity created by fusion, solar heat, tides, fuel cells and wind power.
>
> "While experts argue on when we will run out of natural gas, all agree that we will deplete our supplies of this clean fuel in the near future. What then? Will those homes and businesses that are converting today to gas be forced to rip out their gas furnaces in a few years? Will they use those same heating systems to burn synthetic fuels? What will be the cost of future synthetic fuels? What will be the environmental cost?
>
> "When fuel supply scenarios change, the electric utility has the flexibility to change the fuel used to generate electricity, moving from gas to oil to coal. However, fuel switching is costly and difficult for the typical residential consumer at the point of use.
>
> "What are the real energy costs of the current weighting factors in BEPS? Many parts of the country do not have a natural gas distribution system. What is the cost, in net energy, of digging trenches, laying pipelines and creating new and larger gas distribution networks?
>
> "Building new gas distribution networks will also speed the day we run out of natural gas. When consumers are no longer able to get natural gas, they will turn back to oil or, more likely, to electricity."

Another practical impact of the weighting factors as pointed out by the NAHB, is that in many parts of the country it appears impossible to build a house with electric resistance heating that can meet the weighted budget for electric energy. NAHB points out that in many areas of the country, electric baseboard heating is not only popular, but also efficiently used because of room-to-room zone control. It is also a low cost means of providing heat to a building that will not be centrally cooled. NAHB concludes that the weighting factors are tantamount to imposing a moratorium on new home construction in areas dependent on electric heating and will cause a disastrous ripple effect in the national economy. In support of the potential magnitude of the problem, a recent survey by the NAHB Research Foundation determined that in 1978 baseboard electric heat was installed in 50 percent of new homes in Maine, 40 percent in New Hampshire, 49 percent in Vermont, 32 percent in Pennsylvania, 22 percent in West Virginia, 27 percent in Idaho, 32 percent in Montana, 24 percent in Oregon and 27 percent in Washington.

A number of negative impacts on the electric utility industry and on electric energy prices are also foreseen. Several of these were summarized by the American Public Power Association as follows:

> a. "Public power systems make relatively heavy use of hydro power, and anticipate that this reliance will continue. BEPS is silent on the significance and the potential of this clean and desireable method of obtaining energy.

b. "APPA members would have to continue to add new generating equipment to supply summer peaks. However, they would be denied the opportunity to use this capacity to supply the winter peak, because of less use of electric heating.

c. "Utilities would be forced to increase reliance on older inefficient, combustion turbines built to meet summer peaks. These units generally use oil and gas. Reduction in off-peak generation needs would generally be in base-load plants that use coal and nuclear fuel.

d. "The resulting reductions in overall system efficiency will raise the average unit cost of the kilowatt hours that are delivered, raising the cost of electricity to the consumer."

The specific impact on the further development of conservation techniques and methods by the utility industry is expanded on by the National Coal Association as follows:

> "Moreover, BEPS would similarly discourage the possible use of innovative conservation technologies. The experience of one major coal-based utility system clearly demonstrates that such methodologies as electric storage heating can produce dramatic reductions in peak load energy usage. Where significant use of thermal energy storage devices is coupled with the availability of electricity at off-peak rates, for later use of the stored thermal energy during peak load periods, energy customers can achieve significant economic savings.
>
> "Further, allowing electric generating facilities to operate during off-peak periods at levels closer to their optimum output levels increases the efficiency of generation, and both energy and fuel savings are realized. A time-of-day rate tariff filed by the American Electric Power Company has been approved by the Public Utility Commission of Ohio, and the use of this innovative regulatory and energy storage technology shows great promise.
>
> "Such electric energy storage options would be discourage to the degree that future applications of electric heating and cooling are discouraged.
>
> "Indeed, the adoption of a national standard (such as BEPS) which creates major disincentives to the use of electricity could discourage the use of heat pump technology, and under-cut the rapidly developing concept of peak load pricing as a means of both conserving energy and reducing the cost of energy delivered to the consumer.
>
> "Finally, the use of a standard containing weighting factors such as those in BEPS will increase the cost of energy to all electricity consumers. The inability of utilities to use the most efficient load growth management and distribution methods will increase the marginal cost of electric service to all customers."

In addition to the foregoing types of impacts envisioned as resulting from the use of weighting factors, there are also numerous concerns on the accuracy and appropriateness of the weighting factors numbers themselves.

Most of these tend to point up the fact that the proposed national level factors simply do not account for regional or local availability of fuel or efficiencies and costs in their production, sale, and distribution.

Evidence of the deficiency of national level factors is provided by the following statistics provided by the Southern California Gas Company on electrical generation in the state of California for July, 1978, through June, 1979.

Fuel Type	% of Total Electrical Generation	% Conversion Efficiency
hydro power	13.3	90
coal	7.6	30.1
nuclear	5.8	32.2
geothermal	4.1	18.6
fuel oil	43.6	30.1
natural gas	25.1	32
other	.4	---

Further, in comments to DOE, the Commissioner of the Department of Buildings of New York City indicates that "The fuel weighting factor takes no cognizance of two major sources of fuel which are presently being utilized to a moderate extent, and will probably become more so as time goes on; namely, coal and wood. In addition virtually all of the borough of Manhattan, south of 96th Street, uses steam furnished by a public utility, whose primary sources of energy are variable. Further, thousands of buildings in this city have now converted to a dual fuel (gas/oil) capability. The methodology in the proposed rule does not at all appear to cope with all of the foregoing." He went on to make several additional points as follows: "The fuel weighting factors, which heavily penalize the use of electricity, would be an inequitable burden for this city, this state, and the northeast, which has few options at present, and even for the next decade. Moreover, the effect on the environment has not been thoroughly explored, if because of such penalty on site generation is widely opted for. Also the future will, in addition to the comments made above, undoubtedly see other changes in basic fuels used. If the present factors are held firm, there will undoubtedly be an increased use of portable, relatively inefficient plug-in appliances, to circumvent the design penalty for building designs using electricity for building systems requirements."

APPA points out that the margin of error introduced by assuming the national average for fuel cost as opposed to regional cost is too great to be ignored. They also point out that the proposed weighting factors were based on national energy price forecasts made some three years ago. Due to the tremendous price escalations since then, and a number of deregulation actions taken by the Government, these forecasts are not seen as valid.

From an operating utility's point of view, the Baltimore Gas & Electric Company (BG&E) sees that based on actual metered data for homes and businesses using gas and electricity in their territory, a three-to-one penalty against electricity is patently incorrect. When transmission efficiencies were applied to the measured use of gas and oil, they found that the ratio of source energy for electric resistance heating to gas heating was closer to 1.7 to 1; not 3 to 1.

BG&E also indicated that the heat pump to gas heat ratio was 1 to 1, a finding they felt particularly significant in the Baltimore area where in 1979, of the 16,000 dwelling units completed, nearly 11,500 or 70 percent had heat pumps installed. In addition, 90 percent of all electric heating installed in BG&E areas was in the form of heat pumps.

One of the few proponents of weighting factors, the American Gas Association (AGA), states that in the absence of some form of weighting factors, " . . . the application of performance standards could, among other things:

- Cause more natural resources to be consumed.
- Increase building operating costs.
- Increase the impact of new buildings on the environment.
- Increase inflation.
- Lower the quality of construction."

AGA further states,

> "If the BEPS are not based on source energy usage they will not be responsive to the purpose of the law - to assure that reasonable energy conservation and maximum practicable energy efficiency improvements are incorporated in new commercial and residential buildings. In addition, the following events are likely to occur if the budgets are based only on on-site energy.
>
> - All new construction will utilize electricity for all purposes.
> - Operating costs for these structures would be higher.
> - Reliance on nuclear energy would increase.
> - Air pollutants and solid wastes would be 10 times that produced by the present fuel mix.
> - The gross national product would be $7.9 billion in 1985, increasing inflation.
>
> "In essence, all the adverse effects resulting from an all electric economy would come true.
>
> "Resource based budgets; aside from meeting the intent of the law, national energy policy and being technically accurate would:
>
> - Result in more national energy resources being conserved for the future.

- Higher quality construction and building systems.
- Lower environmental pollution.
- More real income for American consumers.

> "Development of the performance approach to building energy use must be based on the least common denominator - natural resources. To develop and promulgate standards on any other basis is technically incorrect and is not in the best interests of the country."

The widespread existence of the types of issues and concerns represented by the foregoing discussion appears to be one of the major constraints on achieving positive support for the BEPS program. Not only does the use of weighting factors add an additional layer of complexity to cloud understanding of the proposed rules and regulations, it also increases the range of uncertainty surrounding the actual numbers proposed in the NOPR. In addition, the weighting factors are seen as discriminating against the electricity sectors of the energy and building industries. Quite naturally this will encourage extensive discussions and entrenched positions which will require an equally comprehensive response and defense on the part of DOE.

In conclusion, we raise the question that since almost 70 percent of the energy savings of the BEPS program are expected to result from decreased use of electricity, could this end not be achieved at much less cost and disruption through other than the regulation of the design energy efficiency of buildings.

Finding:

The NOPR and its supporting Economic Analysis focus almost exclusively on composite, national impacts and fail to provide an adequate assessment of the potentially significant impact on specific regions of the country and sectors of the economy.

Discussion:

Several key and topical issues with respect to the assessment of the potential economic impacts of the BEPS are found in the statement of the National Electrical Contractors Association (NECA). The electrical construction contracting industry consists of over 37,000 businesses employing over 330,000 workers -- 98 percent of which are small businesses -- with an annual volume of almost $15 billion. According to the Association, the BEPS proposal as contained in the NOPR would be disastrous for the electrical construction industry since it would experience the negative impacts on the construction industry in general as well as the impact of the weighting factors which "blatantly discriminate against the use of electrical energy."

In view of the fact that almost 70 percent of source energy savings from the proposed standards will come from the reduced use of electricity, regardless of how it is generated, the NECA feels that the consideration of the economic impact of this on the entire electrical industry is wholly inadequate. An Association study shows a number of major impacts such as: a 28 percent decrease in the installation of fluorescent light fixtures, lamps, and ballasts; at least a 6 percent decrease in all electrical wiring; 5 percent in conduit and switchboard installations; and 8 percent in panel board installations. A DOE study indicates that using source energy factors, electric heating in the commercial sector will drop from about 29 percent of the market to only about 2 percent and that in the residential sector, electric heating products will drop from about 34 percent of the market share to around 2 percent. Yet the impacts of these market losses on manufacturers of electric resistance heating equipment, electric heat pumps, distribution equipment lamps and ballast are not discussed. The impact on electrical contractors who may be replaced by mechanical contractors has also not been addressed by DOE.

Others point out that the impact on the electric utility sector has not been analyzed. The effect of reduced load factors on a utility's economic vitality, construction costs, and rates is totally ignored in the NOPR's Economic Analysis.

The American Consulting Engineers Council (ACEC) summarized the prevalent feeling toward the Economic Analysis as follows:

> "The Economic Impact Analysis presents us with a thorough and seemingly well executed assessment of the overall national economic impacts. The conclusions reached, on a national scale, are generally positive and favored over adverse impacts which may occur within certain segments of the building industry. Our reading of the economic summary reveals a serious lack of concern for the smaller scale, localized (or regionalized) impacts on material supplies, employment, construction processes, and a locality's economic base. Sample studies of specific metropolitan circumstances should have been conducted to better determine the degree and cost of community-wide distruption relating to employment and construction activity in those areas. If such studies were conducted to arrive at the conclusions in the economic summary, we find no reference to them in the Economic Impact Statement."

The ACEC also expressed a strong desire to learn of the standards' potential impact on (1) design firms, (2) local construction permit offices, (3) construction contractors who must review the plans for quantity takeoffs, (4) local material suppliers who must respond to orders placed by general contractors and subcontractors, (5) localized labor supply problems, (6) inspection services required for specific regions and/or building types and (7) manufacturers who must create new products for the new duties.

The Council also expressed the following concern with respect to the overall format and content of the Economic Analysis:

> "ACEC is fearful that the economic analysis has segregated out some adverse impacts and compared them individually to the conclusion of positive impact on the nation. Taken in combination, the total negative impact of all adverse characteristics may far exceed the positive value to the nation of the proposed standards. The prediction of competitive shifts within the building industry, including expectations of new employment opportunities for construction laborers, may be entirely offset by declines in employment and capital investment in the utility sector. Further reductions in available revenue, reduced leverage for owners intending to build, higher interest rates, and reductions in production among material manufacturers and slowdown in building pace may alter the conclusion that the standards will have a net positive impact. We have seen no collective assessment of all adverse impacts balanced against all positive impacts. Our conclusion is that further study is needed to verify that positive impacts will dominate the negative factors."

In addition to inadequate consideration of the impacts on specific sectors of the electric and the building industries, NECA and other organizations point out other problems that may slow down the entire construction industry. For example, the estimates of increased first costs of construction -- 3 to 5 percent in commercial building and $1/sq. ft. in residential projects -- are considered much too low particularly since they do not take into account any additional costs to designers in adopting and using BEPS and its compliance procedures. Several organizations suggest that increased costs of construction can be more than 2 to 3 times larger than those set forth above when factors such as the following are considered: increased design time, code compliance, manufacturing problems, re-tooling for smaller heating units and additional site labor for handling larger quantities of insulation, lumber and glass materials. In addition, BEPS has the real potential of increasing construction delays because it effectively prohibits traditional equipment substitution procedures which are generally used to expedite construction.

As pointed out in the earlier discussion of weighting factors, another major impact on the homebuilding industry in particular might be a dramatic slow down or even moratorium in those geographical areas and regions dependent on electricity for heating purposes.

Finding:

Both the public and private sectors are likely to encounter significant financial and technical difficulties in carrying out their responsibilities under the BEPS program and will require substantial additional resources in order for the program to be successful.

Discussion:

Section 308 of the Energy Conservation and Production Act (P.L. 94-385) states that the Secretary "may provide technical assistance to states and units of general purpose local government to assist them in meeting the requirements of this title." Technical assistance for all segments of the building community is an essential feature of the BEPS implementation.

Organizations such as the National Association of Home Builders (NAHB) have indicated that evaluation techniques such as the SET are beyond the present capabilities of most builders, building code officials, and design professionals. Implementation of the BEPS through existing code mechanisms will therefore require a massive educational effort. The National Lumber and Building Materials Dealers Association estimates that such a program would include 20,000 building code officials from at least 8,000 permit-issuing jurisdictions as well as 100,000 builders and a similar number of general and specialty contractors. This number does not include the thousands of architects and engineers who will also require training in the understanding and application of the BEPS.

Another comment on the implementation of the BEPS states,

> "Successful implementation of the program does not come free. Much work must be done to prepare industry and code personnel to their responsibilities under the program. Funds will be needed for additional standards research, conduct of training and educational programs, technical assistance to state and local code officials, monitoring and program administration.
>
> "DOE will be implementing this program which will require designers, builders and code officials to rethink the way they have normally conducted business. Our experience, based on working in hundreds of local code jurisdictions, is that few individuals are prepared to deal with performance standards and computer programs. Most people in construction are not professionally trained. Their knowledge does not presently extend to the sophisticated capacities called for by computer technology. They therefore will need substantial training and educational assistance from DOE which will take both time and money."

While a comprehensive technical assistance program is critical to acquaint all members of the building community with the BEPS, such a program must be sensitive to certain inherent shortcomings and limitations. Many of these problems are reflected in a case study of the state of Colorado, prepared by NIBS to assess that state's efforts to implement its thermal efficiency standards. As part of the implementation program, the Colorado Office of State Planning and Budgeting, together with the Division of Housing, sponsored a series of programs to guide and assist local building officials and interested members of the building community in the implementation of the state's building energy conservation code.

These two state offices conducted a series of ten conferences across the state. Presentations were directed toward local government administrators, building officials and design professionals. While the workshops accomplished their primary purpose of educating members of the building community with thermal efficiency standards, there were a number of problems that emerged over the course of the training sessions. First, the state lacked experience in the implementation of the energy standards. As a result, the staff did not have an adequate experience background to enable them to devise meaningful training sessions. Second, there were vast differences in the technical assistance needs of urban and rural jurisdictions. Larger local governments, such as Denver and Colorado Springs, generally had more highly qualified staffs than small towns where limited construction activity often required only a "staff" of one part-time building official with a limited engineering background. Third, many building departments are understaffed, and the lengthy training sessions (one or two full days) caused them to fall behind in their other official duties. Conversely, other building code officials complained that the training sessions were too technical and covered the material too quickly.

The Colorado effort is typical of the types of the problems experienced by other state and local governments to train building officials, builders and design professionals with thermal efficiency standards. A training and technical assistance program would have to be sensitive to these types of problems in order to be as meaningful as possible to its participants. Lack of experience with the BEPS or other thermal efficiency standards, diversity of educational background and time constraints are amplified when transposed to the national level.

A related problem that will be faced by DOE is described in the follwing statement.

> "Implementation would be set back if DOE worked solely with the States. Enforcement of this program will be local as confirmed by historic patterns of code enforcement and recent experiences under the SECP [State Energy Conservation Plan] program. Instead of fifty jurisdictions we are talking of thousands of jurisdictions. A State only perspective also ignores the competition and conflict that exist between state and local governments."

Technical assistance in itself is insufficient to launch an effective implementation program. In addition, Federal financial assistance will be required to augment state and local budgets. The Department of Energy noted in the NOPR that local enforcement is hampered by limited fiscal resources and by the multiple duties that local building officials are required to perform. The BEPS program will require additional funds for such activities as training, enforcement, increased human resources and other technical and administrative preparations.

The financial constraints placed upon state and local building departments is exemplified by Massachusetts, the subject of another NIBS case study. An analysis of the state's building department regime yielded the following findings: Staffing within the State Building Code Commission for energy code implementation is entirely supported by Federal funds received under P.L. 94-163. Twice as many staff members are required to operate the state's energy program than staff all other sections of the state's building code. Further, state budgetary restraints have caused state funding for general code administration to decline over the past three years.

The Massachusetts case study reveals many of the shared financial concerns of jurisdictions around the country. For example, the Superintendent of Building Inspection for the City of Akron, Ohio, emphasized that funding of cities for enforcement of the BEPS program is "essential" to cover computer costs and manpower. The Superintendent also noted that financial assistance must be channeled directly to local governments without giving the state an opportunity to "siphon off" a portion of the funds.

An exact measure of additional costs that will be incurred by code enforcement agencies cannot be determined until implementation actually begins. However, ASHRAE projections based on field experience indicate that an increase of at lease 15 percent in the budgets of local enforcement agencies will be required. Without financial assistance to cover the added state and local costs, effective implementation of the BEPS program will be severely limited.

Finding:

Further analysis is needed regarding potential liablity under BEPS of design professionals, code officials and builders/owners.

Discussion:

A shared concern of all segments of the building community is whether and to what degree the energy performance standards program will expose each of them to potential liability. The National Society of Professional Engineers (NSPE) raised the issue of professional liability of a design engineer where a building consumes more energy than permitted by the design. Similarly, the Steering Committee of the West Virginia Chapter of the National Institute of Building Sciences' Consultative Council expressed concern that the burden of increased liablity insurance would fall on designers and builders in having to guarantee results in conformance with DOE requirements. These representative comments suggest that the issue of potential liability has professional, practical and financial ramifications which affect all segments of the building community.

The question of potential liability of design professionals was first raised at a meeting of the American Institute of Architects in March, 1977. Professional design organizations have stated that an architect or engineer should properly assume responsibility for that portion of the project over which he exercises control; that is, building design. Design professionals and builders recognize that they should not be completely insulated from litigation where they have committed errors or omissions in their work. Instead, they urge that DOE, together with state and local code enforcement personnel, work with them in identifying specific areas of liability and specific areas where they will not be liable.

Design professionals are also concerned about the impact of the BEPS program on their professional liability insurance. One area of special concern arises in connection with the proposed requirement in the applicable approval process that design professionals evaluate and "certify" that their building designs comply with the BEPS.* At present, design professionals are generally prohibited from "certification" (or guarnatee) of their building plans under the terms of their liability insurance. (Report of the Energy Task Force, Building Owners and Managers of Atlanta, Inc., February 5, 1980, page 2).

ACEC and other professional organizations oppose this possible requirement, primarily because they fear that they will be held accountable for instances where the building consumes more energy than the building design indicates. They do not want to be held liable for matters outside their control, such as construction, operation, or maintenance of the buildings they design. However, in anticipation that the requirement of evaluation and certification of building plans is required, organizations such as the ACEC have been working closely with insurance underwriters to develop an affidavit to be submitted when architects and engineers undertake to certify compliance of the building plan with

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* Plan certification should not be confused with certification of an equivalent code.

BEPS. This affidavit is still in the draft stage, but presently reads:

> As a registered engineer (or architect) in the State of ________, I hereby attest that to the best of my knowledge and belief, (name and address of building) has been designed in accordance with the U.S. Department of Energy's Building Energy Performance Standards and has been simulated to have a design energy performance of (xBTUs/sq. ft./year), based upon assumptions of equipment performance, climate conditions, and information on building operating conditions provided to me by the U.S. Department of Energy and the building owner.
>
> Signed ____________________
> Registered Engineer (Architect)

The problem of evaluation and certification does not only arise in connection with the applicable approval process. DOE is also considering a similar requirement for all buildings over 50,000 gross square feet, even where the state or local government has a certified equivalent code in place. If a design professional is given this responsibility under either the AAP or a certified code, organizations such as ACEC and others have indicated a desire to see an affidavit such as the one included above, approved by DOE and endorsed by insurance underwriters and design professionals, ultimately included in the final implementation rule.

Such an affidavit, even if included in the Final Rules, will not provide a panacea to the liability issue. Design professionals and builders are unsure what impact the BEPS program will have on their responsibilities after evaluation of the building design. This might encompass areas such as whether there would be a duty to redesign a building when the building inspector refuses to issue a construction or occupancy permit. While issues such as these should be determined on the basis of the contractual obligation between the design professional and his client, the building community has expressed a desire to see these matters addressed by DOE and others.

Code administrators are also concerned about their exposure to liability in the performance of their official duties. Like design professionals and builders, it is not yet clear whether they will be exposed to liability arising pursuant to the administration of a certified code or the alternate approval process. Further, it is unclear whether code administrators will be shielded from liability under the principle of sovereign immunity. This is in part a function of state and local law, but DOE clarification and guidance may serve as a valuable contribution to the formulation of state and local law.

The scope and ramifications of potential liability arising under the BEPS program has many other facets which have not yet been explored. For example, will a building owner be liable to a subsequent purchaser if the building consumes more energy than the design energy budget? What are the cost ramifications of the liability issue? Will design professionals' liability insurance rates increase significantly, and, if so, how much of this cost will be carried on to the consumer? These and other concerns strongly indicate that further analysis is needed with respect to the potential liability of code officials, design professionals and builder/owners.

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Finding:

As estimated by DOE in the NOPR, the proposed standards will result in less than 4 percent of the energy savings anticipated by Congress at the time it passed P.L. 94-385, raising the question of whether or not these or greater savings in the energy consumption of new buildings could be achieved by other and more cost effective means.

Discussion:

A second set of issues concerning the economic analysis are raised with respect to the current validity of the overall costs of the BEPS program versus the benefits to be realized. For example, current DOE projections of energy savings from the standards of the equivalent of 100,000 barrels of oil per day by 1985 and 216,000 barrels per day by 1990 are less than 4 percent of the estimates of 6 to 12.5 million barrels (equivalent) per day reported to Congress at the time it passed P.L. 94-385. Stated in another way, DOE's projections indicate that BEPS may reduce the nation's energy consumption by about 0.6 percent during the critical period from 1980 to 2020 as opposed to close to the 15 percent originally estimated.

To emphasize the small magnitude of the energy savings that are estimated to result from the proposed standards, the following comparisons are offered by one respondent to the NOPR:

- "A 10 percent reduction in the total annual heat loss through windows of heated buildings in the U.S. would roughly equal the saving levels that DOE expects to achieve within ten years after implementing BEPS.
- "Stopping the annual infiltration heat loss through electrical outlets and switches can save several times as much energy as that saved by implementation of BEPS.
- "Using one less 100-watt light bulb per home can obtain energy savings exceeding those achieved during the first several years after implementing BEPS."

The respondent making these estimates concluded:

> "In view of the trivial percentage reduction in energy consumption projected for BEPS, one must ask whether implementation will produce benefits commensurate with the price which must be paid. As with all federal regulation, BEPS will abridge individual freedom of choice, tie up building design in a complex web of rules, and add new burdens to those engaged in innovative concepts for energy conservation. Concerns are widely expressed that BEPS will be costly, burdensome, controversial, and difficult from the standpoint of compliance and enforcement."

The foregoing argument becomes increasingly compelling when one considers that the apparently modest energy savings are based on a comparison with design and building operating practices and the market environment that prevailed in 1975-76. Improvements in energy performance since then are reflected in the following statements of the National Association of Realtors:

> "We firmly believe this regulation may be obsolete in light of the significant policy shifts and resultant market forces that have come into play since BEPS was authorized by the Energy Conservation and Production Act of 1976. Since this law was enacted government policies have shifted from regulated prices of natural gas and oil, which kept energy prices artificially low and thwarted conservation incentives, to the deregulation of energy prices with accompanying price increases. This shift is providing dramatic market incentives to conserve energy throughout all sectors of our society, including the building sector. We are convinced, based on current trends of increased building energy efficiency, that the market incentives resulting from recent Federal deregulation of energy prices will do the job that BEPS was designed to do four years ago when government pricing policies were subsidizing wasteful energy use.
>
> "The greatest mechanisms for encouraging energy conservation have been and we feel will continue to be the forces of the free market. Escalating energy prices have forced the housing market like other sectors of our economy to streamline their operations and increase efficiency dramatically. Home buyers are more concerned than ever with the energy efficiency of their new purchase and it is invariably one of the first concerns expressed in the housing transaction. In fact the study commissioned by the Dow Chemical Company during September of 1979 indicates a full 95 percent of homeowners believed that energy saving features are important in a new home. Furthermore these same respondents believed that the energy saving features in 83 percent of the cases will add to the resale value of the home. It is very clear the market is responding rather convincingly.
>
> "Great strides have been made and continue to be taken by the industry to increase the thermal performance of homes. For instance we know that the annual adjusted residential energy use growth rate has been reduced from an average of 4.7 percent growth during the period of 1960-1970, to a growth rate of only 2.6 percent during the 1977-1979 period. In addition it is estimated that the typical single family home built today consumes some 40-50 percent less energy than one built in the 1973-1974 period following the oil embargo. A 1977 study by Professional Builders confirms that builders are including energy saving features increasingly. For instance, in the past two years 83 percent have increased attic ceiling insulating, 67 percent have switched to double and triple window glazing, improved weather stripping and have employed various other energy features in their new homes. These findings are underscored by the annual report of the NAHB Research Foundation which highlights increased levels of insulation, greater use of double and triple glazed windows, and increased utilization of innovative heating systems such as heat pumps. Energy conservation packages, which include a number of energy-saving measures,

> are a common sales tool for new home sellers and buyers are responding enthusiastically.
>
> "The Department of Energy estimates that the BEPS standard will save 21-50 percent in the residential sector. However, in that these projections are based on 1975-1976 construction data, we believe these may be lofty estimates at best. The bottom line is that before we implement what is certain to be a costly, complex and potentially disruptive standard, the Federal government should prove it will save a significant amount of energy above and beyond the efficiencies realized as a result of market forces. Current market trends seem to point to the fact that federal regulation in this area may not be desirable or necessary."

Other examples of changes that have occurred since 1975-76 include: the widespread adoption and initial implementation of the ASHRAE 90-75 standard in 41 states; the preparation and distribution by the National Electrical Contractors Association (NECA) of a practical handbook for building owners and managers covering energy audit techniques and an on-going conservation management program which can result in a 35 percent savings over pre-1975 energy use levels; and, the development and use by NAHB of Thermal Performance Guidelines which are simple and straightforward in balancing the local cost of fuel with the associated systems' efficiencies.

Finding:

The Department of Housing and Urban Development, and subsequently the Department of Energy, failed to adequately consult with the building community in the development of the performance standards to the extent required by P.L. 94-385.

Discussion:

Section 309 of P.L. 94-385 stipulates that:

> "Sec. 309. In developing and promulgating performance standards and carrying out other functions under this title, the Secretary shall consult with appropriate representatives of the building community (including representatives of labor and the construction industry, engineers, and architects), with appropriate public officials and organizations of public officials, and with representatives of consumer groups. For purposes of such consultation, the Secretary shall, to the extent practicable, make use of the National Institute of Building Sciences. The Secretary may also establish one or more advisory committees as may be appropriate. Any advisory committee or committees established pursuant to this section shall be subject to the provisions of the Federal Advisory Committee Act."

The response of DOE and HUD to the Section 309 mandate for building community consultation has at best been uneven and, in the case of the standards development effort (as distinguished from the promulgation effort), creation of a thirteen (later fifteen) person Technical Advisory Group (TAG) has been the only formal step taken by DOE or HUD in the three years of the program, aside from the Advance Notice of Proposed Rulemaking (ANOPR) and NOPR public hearings, to assure systematic input and consultation by the building community. Clearly the Congress in writing Section 309 intended a far broader and more systematic representation process than was, or indeed could be, achieved by a thirteen or fifteen person advisory committee. Section 309 specifically provides for consultation with "representatives of labor and the construction industry, engineers and architects, public officials and organizations of public officials and with representatives of consumer groups." As the TAG committee members themselves pointed out in their final report, TAG was not, nor was it intended to be, representative of the various interests and concerns of the building community. Indeed, the TAG members did not even officially represent the five professional engineers societies and two building associations (American Consulting Engineers Council; American Institute of Architects; American Society of Heating, Refrigeration and Air Conditioning Engineers; Illuminating Engineers Society of North America; National Society of Professional Engineers/Engineers in Private Practice; National Association of Home Builders; and the Manufactured Housing Institute) of which they were members. The TAG report of October, 1978, noted in this regard:

> "From the outset, it was clearly understood that TAG, although its membership included members of five different technical societies, could not take an official stand or speak for their respective societies. They could only speak as individual society members rendering their best judgment and input at all times and reporting their activity back to their societies. Thus, it is in this role of reporting that the TAG members have developed this joint statement of their stewardship for presentation to each of the societies."

Aside from its lack of representativeness of the building community, the TAG was often frustrated in its efforts to provide an effective linkage between government and industry in the standards development effort by DOE's and HUD's reluctance (1) to allow general dissemination of key project data and (2) to give adequate weight to the TAG's advice and counsel. In their October, 1978 report the TAG members identified a number of areas in which they had expressed concerns which had been largely ignored or put aside by DOE and/or HUD for lack of time. Many of these concerns have subsequently been proven to be correct and to raise serious questions about the validity of the BEPS as currently proposed. Among the concerns listed by the TAG in their report were the following:

> "The time limitations in both Phase I and II forced decisions which were not always in the interest of developing the best performance standard.
>
> "Even though 1,661 teams of design professionals responded does indicate that there was a very high degree of cooperation; this was still a volunteer effort and the quality of the data collected in Phase I left something to be desired. This has some bearing on the acceptability of the results.
>
> "The manner in which the data were collected causes concern. A definite lack of knowledge existed among the participants on how to provide proper and adequate data for the computer runs. Process loads, for example, including domestic hot water, elevators, office machines, computers, etc., were not considered in the energy calculations in Phase I.

"The lack of an adequate reference base on actual energy use of existing buildings made it impossible to validate the computer results with what actually happens in buildings.

"There appeared to be an inbalance in the level of effort between Phase I and II, as well as an imbalance between commercial and residential when their portion of total energy usage is considered.

"Although the TAG requested additional information which should have been available to AIA/RC [American Institute of Architects/Research Corporation] , but only limited data was was provided to the TAG. As a result the TAG was not able to advise or make recommendations on this portion of the Phase I effort. The available data was derived from an extensive survey of more than 100,000 houses which was done for another purpose.

"Although the TAG agreed to the use of AXCESS as the only readily available alternative, it was continually pointed out that no single universally acceptable program now exists which will evaluate all energy conserving features that may be designed for buildings. Several factors which are not handled well in existing programs are the effect of natural light on the air conditioning system, the effect of natural ventilation, the effect of attic ventilation to reduce the effective temperature of the roof, to name but a few. Thus a major problem was created in evaluating the Phase II redesigns on a uniform basis since many designs used some of the above items and/or similar other items that are difficult to calculate.

"The TAG discussed the various units in which the results should be expressed; such as BTUs per square foot per year, BTUs per cubic foot per year, BTUs per occupant per year, and BTUs per function on an annual basis. KW versus BTU was also considered. No positive conclusion was reached by the TAG, and more importantly sufficient effort was not expended to determine the best units.

"The TAG discussed, in detail, fuel equivalency and agreed that no acceptable equivalence factors now exist. Some members of the Group believe the issue should be avoided and the problem of conversion efficiencies treated in a separate research effort.

"The TAG was concerned that the heat available from process loads was not considered in the load calculations or the energy use calculations of the AXCESS program. The TAG and AIA/RC are well aware that in many structures, there will be adequate waste to provide for the entire building heating energy.

"The TAG members identified the lack of training in control technology as a major concern.

> "The TAG expressed deep concern for the enforceability of performance standards; both the ability of the design team to use them appropriately and the ability of the regulatory agency to implement them, particularly in light of the limitation of currently available analytical tools.
>
> "The TAG also continues to be concerned with the possible costs associated with enforcement, and the financial burden which may have to be borne by the design professionals and/or the client."

As noted earlier, the validity of many of the above concerns have been borne out by subsequent events, underscoring the importance of an effective consultation process.

Finding:

Because of existing constitutional, legislative and statutory requirements many states and local jurisdictions will require at least 3 years to adopt and effectively implement BEPS. Further, the private sector will require substantially more than 12 months to become proficient in the application of the standards and to build up inventories of the equipment and materials required to meet the BEPS requirements.

Discussion:

Public comments and the results of BEPS-related research militate strongly in favor of the finding that the program schedule, as stated in P.L. 94-385 is unrealistically short. An attempt to implement and enforce the BEPS program within one year from the date of promulgation of the final performance standards will result in serious disruption to state and local governments, code administrators, and all other segments of the building industry.

Under Section 305 of the Energy Conservation and Production Act (P.L. 94-385), states are required to certify that either the state or its local governments have adopted and are implementing a BEPS-equivalent code. Alternatively, a state may develop and administer an "applicable approval process" (AAP), which is defined in Section 305(b)(3) of the Act to mean a mechanism and procedure for determination and approval that a particular building design is in compliance with the final performance standards.

It is unlikely that states can complete either certification procedures or establishment of the AAP within the timeframe allowed under the Act. Building and thermal efficiency codes are promulgated by state and local governments. At present, there are more than 12,000 separate code jurisdictions in the United States. While code enactment and amendment procedures vary according to state and local law, this process is generally slow and cumbersome and, in many instances, will take longer than one year. For example, the State of Texas presently has no statewide building or energy conservation code in effect. The State Legislature convenes every two years, which means that if a code is not enacted next term, then no legislative mandate will exist until at least 1983. After legislative enactment, additional time is required for the administrative procedures associated with promulgating the code. According to a study prepared by NIBS of state building code and energy conservation enactments, the Texas code amendment procedure is fairly typical of the procedures of many other code jurisdictions around the country.

These time projections for state implementation activities do not include the additional time required for federal approval of state certifications. ASHRAE also points out that projections do not allow for ancillary activities such as local adoption of state codes or the training of local code officials and members of the building community.

Since it will probably take longer than a year for states to put certified equivalent codes in place, DOE anticipates that the AAP will be widely used in the interim. However, it is unlikely that even a AAP can be instituted on a comprehensive basis within the permitted time schedule. In a report to the Congress, the Comptroller General found that at least six states have no administrative framework in effect to regulate construction or thermal efficiency standards. The Comptroller General also found that 24 states will have to amend or modify their current energy conservation legislation to make it applicable to all new construction rather than just certain building types. As in certification, additional time will also be required for training code officials and design professionals, and for completing necessary administrative/technical preparations.

Thus, it is unlikely that state and local governments will be able to institute either certified codes or an AAP within one year. Any attempt to do so, in light of the threat of economic sanctions, will foment confusion and unnecessary tension between the federal government and state and local governments. This, in turn, will inevitably generate local resistance to implementation of the federal BEPS in an area of traditionally local regulations.

Similarly, an attempt to meet the timeframe established by P.L. 94-385 will adversely impact code administrators. Numerous efforts have been made to acquaint building officials with the BEPS. However, NAHB indicates that implementation of the BEPS (for example, use of the SET or other computer evaluation techniques) is beyond the present capability of most code officials. A great deal of time (and money) will be needed to train local code administrators in the use of the SET and other prequalified equivalency tools, once they become available. To understand the magnitude of this educational effort, the National Lumber and Building Materials Dealers Association estimates that at least 20,000 building code officials, 100,000 builders, and 100,000 general and speciality contractors must be trained nationwide in order to implement the BEPS. Design professionals will also require training to acquire an expertise in application of the BEPS.

Implementation of the BEPS program within a year will also have a disruptive effect on the building industry in general. As indicated above, the massive training effort will necessarily be time-consuming. In addition, certain suppliers have indicated that they will not be able to meet this time schedule. For example, insulation manufacturers and suppliers have indicated that they would not be able to keep pace with the increased demand for their products and services.

The Energy Policy and Conservation Act (P.L. 94-163) provides an additional basis for comparison of problems which are likely to be encountered. Under P.L. 94-163, a state was eligible for federal financial assistance to develop a comprehensive energy conservation plan to meet 1980 energy conservation goals. This plan was to include mandatory lighting efficiency standards for public buildings, and thermal efficiency standards and insulation requirements for new and renovated buildings.

In its Report to the Congress dated January 28, 1980, the Comptroller General found that many states did not enact thermal efficiency standards by the January 1, 1978 target date - 15 months after the first set of DOE regulations. The Report states that only four of the 12 states reviewed had these standards authorized and ready for implementation by January 1, 1978, or shortly thereafter. At present, three years after the DOE regulations, only 41 states have any form of thermal efficiency standards in place.

The National Conference of States on Building Codes and Standards, Inc. (NCSBCS) conducted a survey of these state energy conservation enactments. NCSBCS found that of the 41 states with enabling legislation, only 26 states extend comprehensive application of the thermal efficiency standards to all new construction within the state. The other states have limited coverage to specific building classifications or types, such as state-owned buildings or public buildings. This same study also reveals that implementation and enforcement of the energy conservation standards is limited. For example, only eight states maintain regular monitoring of local administration of the standards, and six other states have a minimal monitoring system (usually on a complaint basis only). The study also indicates that less than half of the states have established any form of training or technical assistance program.

The findings of NCSBCS, the Comptroller General, and DOE itself suggest that compliance with the P.L.94-163 program, after more than three years, is still slow and sporadic. This assessment of the limited progress under P.L. 94-163 suggests that a one-year implementation schedule for the BEPS is highly unlikely to succeed. ASHRAE has therefore urged a phased implementation program to be effected over a three- to five-year period. Similarly, NAHB and NCSBCS have stressed the need for a multi-year pilot program. Given the uniform opposition from all segments of the building community, the current BEPS program schedule should be reviewed to determine whether its maintenance is realistically in the public interest.

In summary, one commentor on the NOPR stated,

> "Change cannot be forced upon this industry and its regulators to meet an overly ambitious timetable without causing significant disruptions to construction activity and failure to meet the goals of the program."

CONCLUSIONS AND RECOMMENDATIONS

The National Institute of Building Sciences (NIBS) supports the development of energy performance standards for new buildings as defined in the Energy Conservation and Production Act of 1976, P.L. 94-385: standards that establish energy consumption goals without specifying the methods, materials and processes to be used in achieving these goals but which include the criteria and evaluation methods for determining if the goals have been met. Performance standards are needed to

1. Establish national goals for the energy efficiency of new buildings,
2. Provide a basis for measuring the country's progress toward these goals, and
3. Foster the technological innovations and permit the flexibility in the design of new buildings that will be required to realize the full potential for increased energy efficiency.

CONCLUSIONS

However, the energy performance standards described in the November, 1979, Notice of Proposed Rulemaking (NOPR) and its supporting documentation will not achieve the above needs. Specifically, in reviewing these documents the Institute has reached the following conclusions:

1. Neither the Design Energy Budgets (DEB's) nor the Standard Evaluation Technique (SET) as presently constituted satisfy the basic requirements set forth below for a viable performance standard.

   A performance standard, to be effective, must meet the following two basic requirements:

   (a) Specify a performance goal that is

   -- Unambiguous and readily understandable
   -- Reasonable
   -- Measurable

(b) Specify a measurement technique for determining compliance that is

- -- Readily applicable and usable
- -- Understandable and creditable
- -- Capable of providing replicable and consistent results
- -- Capable of dealing with the range of variables and circumstances that may reasonably be expected to occur
- -- Capable of producing outcomes that are predictable and consistent with reality

The conclusion with regard to the inadequacy of the proposed DEB's is based on the following findings:

- The validity and appropriateness of the proposed DEB's for commercial and multi-family residential buildings have not been established in a scientific and readily demonstrable manner. The credibility of these numbers is also weakened by perceived shortcomings in the original research and in the numbers themselves, and by the potential that new data, made available by on-going research, may change the numbers in the final rule.
- The DEB's for commercial and multi-family residential buildings are based on an analysis of a small and non-representative sample of buildings.
- Expressing the DEB's for domestic hot water usage in single family residences in terms of BTUs per housing unit, without regard for household size, is questionable and should be re-evaluated. Further, the specific assumptions made in developing the budgets concerning water usage and temperature differential, the outlet temperature less the inlet temperature, are also incorrect and warrant further research. Revising either the unit of measure or the assumptions would change the hot water budgets.

The conclusion with regard to the present inadequacy of the SET as a measurement technique is based on the following findings:

- The proposed SET intends to use a computer simulation method, DOE-2, as the principal technique for calculating the design energy requirements of building designs. DOE-2 is presently inadequate and will remain so until its capabilities are expanded and it is validated.
- Because of the complexity of the SET's computer methods for calculating design energy consumption, the majority of design firms and builders lack both the expertise and financial resources to use them. Therefore, in addition to the SET, more simplified methods of determining compliance with the BEPS will be required.
- The SET, as currently proposed, is not generally useful during the design of the building to help designers make more energy-effective decisions. On the contrary, the SET could actually inhibit the achievement of improved energy performance in new buildings.

2. The proposed weighting factors will, in some instances, produce economic, environmental and energy impacts that may be inconsistent with national goals and undermine the statutory requirement that the Building Energy Performance Standards (BEPS) encourage the use of non-depletable resources. This conclusion is supported by the finding that the inclusion of the proposed weighting factors in BEPS will encourage the use of oil and natural gas and discourage the use of electricity. Further, the weighting factors do not differentiate between hydro-electric power and coal-, nuclear- and oil-generated electrical energy.
3. The original estimate of the potential energy savings of BEPS reported to the Congress at the time of enactment of P.L. 94-385 is no longer valid. Current DOE estimates of potential energy savings are significantly lower than the original projections. The public and private costs of implementing the proposed standards, which have not been adequately addressed in the DOE estimates will be significant and will adversely affect the anticipated benefits of the standards. This conclusion is based on the finding that,

as estimated by DOE in the NOPR, the proposed standards will result in less than 4 percent of the energy savings anticipated by Congress at the time it passed P.L. 94-385, raising the question of whether or not these or greater savings in the energy consumption of new buildings could be achieved by other and more cost effective means.

4. The BEPS will have significant economic, financial and legal impacts on key private and public sectors of the economy and specific geographic regions. These impacts have not been assessed in the detail necessary to either determine their true magnitude or to identify ways to mitigate their adverse effects. This conclusion is supported by the following findings:
    - The NOPR and the supporting economic analysis focus almost exclusively on composite, national impacts and fail to provide an adequate assessment of the potentially significant impact on specific regions of the country and sectors of the economy.
    - Both the public and private sectors are likely to encounter significant financial and technical difficulties in carrying out their responsibilities under the BEPS program and will require substantial additional resources in order for the program to be successful.
    - Further analysis is needed regarding potential liability under BEPS of design professionals, code officials and builders/owners.
5. The proposed rules have been developed without taking full advantage of the technical resources of the building community. This conclusion is drawn from the finding that the Department of Housing and Urban Development, and subsequently the Department of Energy, failed to adequately consult with the building community in the development of the performance standards to the extent required by P.L. 94-385.

6. The current statutory mandate that state and local governments adopt and implement BEPS within one year after promulgation is unreasonable and impossible to achieve. This conclusion is supported by the finding that because of existing constitutional, legislative and statutory requirements, many state and local jurisdictions will require three or more years to adopt and effectively implement BEPS. Further, the private sector will require substantially more than twelve months to build up inventories of the equipment and materials required to meet the BEPS requirements. The significance of this conclusion is reflected in the following statement made in response to the NOPR:

> "Whatever implementation program is ultimately selected must be matched to the realities of the construction industry and of the building code regulatory environment. Construction is highly localized, involving people with limited technical training. Few are familiar with energy standards, fewer yet have used performance standards like BEPS and almost none have a familiarity with computer compliance techniques. Most people who build or regulate want simple rules. They are not predisposed to try new ways. And, if they were willing to deal with new concepts, they have little money to finance the necessary learning. As a result, the construction industry does not change its ways quickly and requires time before new ideas are picked up and are incorporated into practice."

RECOMMENDATIONS

Based on the foregoing conclusions and supporting findings regarding the proposed energy performance standards, the National Institute of Building Sciences makes the following recommendations regarding their further development.

Defer Issuing The Standards

Promulgation of BEPS should be deferred until the technical and structural deficiencies in the proposed standards have been corrected and the manner in which they will be implemented has been determined, even though this will require a delay well beyond the present legislatively mandated promulgation date of August 14, 1980.

Develop Revised Standards

To assure that BEPS and the accompanying implementation strategy will receive national acceptance and support when completed, further planning and work on the total program should be carried out in full consultation with the building community as called for in P.L. 94-385. The total program should be implemented with all deliberate speed and have as its objectives:

- Correcting the current technical and structural deficiencies in BEPS.
- Developing a BEPS implementation strategy and program that will minimize administrative costs and disruption of the normal building regulatory process at the state and local levels.

Further, during the course of devleoping the revised standards and implementation strategy and program, particular attention should be given to:

- Allowing alternate paths for satisfying the requirements of the standards - e.g., subsystem and component performance standards, and prescriptive standards and/or manuals of accepted practice, that most building community participants are accustomed to and currently better equipped to work with.
- Reassessing the concept of weighting factors to determine whether they are of direct significance to building performance, and if it is found that they are not, eliminating them and then assuring that the standards do not otherwise artifically bias the selection of fuels or the selection of heating and cooling equipment.

Promulgate On A Voluntary Basis

At the time of publication of the final standards, the Administration should recommend to Congress that consideration of sanctions be deferred until the building community has had sufficient time to respond to the final standards on a voluntary basis and until the necessity of applying the standards as mandatory requirements has been reassessed.

Parallel Supporting Efforts

In order to sustain the continued development and application of energy conservation standards and to facilitate the introduction of energy performance standards, incentives and other assistance should be provided for the following purposes:

- To enable states that have adopted building energy standards to update and strengthen those standards and to provide for their universal acceptance and enforcement;
- to encourage states that do not have energy conservation standards to adopt such standards immediately;
- to encourage states that have adopted standards for only certain types of buildings to expand their coverage to all new construction; and
- to enable appropriate institutions to initiate educational and training programs in the application of performance standards for fuilding code officials, design professionals, builders, and other members of the building community.

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* Input consisted of response to questionnaire developed by NIBS for its BEPS workshops which were held in Boston, New York, Pittsburgh, Atlanta, Chicago, Dallas, Denver, Seattle, San Francisco and Los Angeles to inform the building community of the contents of the NOPR.

Appendix G

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APPENDIX VI

Energy Conservation in New Buildings, a Report by the Consumer Energy Council of America

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ENERGY CONSERVATION IN NEW BUILDINGS

A Critique and Alternative Approach

to the

Department of Energy's

Building Energy Performance Standards

A Report by the

Consumer Energy Council of America

1990 M Street, N.W.
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April 1980

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EXECUTIVE SUMMARY

This is an Executive Summary of a report to the Department of Energy (DOE) by the Consumer Energy Council of America (CECA) on DOE's Building Energy Performance Standards (BEPS). Under a grant from DOE, CECA has undertaken a comprehensive analysis of BEPS, focusing primarily on consumer, legal and economic impact issues. CECA has reviewed DOE's data and analysis, conducted independent analyses, and developed an alternative approach for setting BEPS.

The Consumer Energy Council of America supports both mandatory standards to regulate energy use in buildings and performance principles for those standards. We take very seriously the strong language that Congress used in mandating the development of standards "designed to achieve maximum practicable improvement in energy efficiency and increases in the use of nondepletable sources of energy." We believe that the nation must do the utmost to conserve energy and that the Department of Energy has been much too timid in pursuing the goal of energy conservation.

CECA's criticism of DOE's analysis is intended to improve research conducted in the future and to convince DOE and others that more conservation is socially desirable, technically possible and economically beneficial in the present. CECA's report to DOE is divided into four parts.

Part 1: New Buildings and National Policy Options: The Program in Perspective

Chapter II reviews a series of major national energy policy studies published in the last two years. CECA concludes the following:

*New buildings present a tremendous potential for energy conservation.

*Their contribution to national energy resources can be greater than any other conservation option and equal to the average production option like synthetic fuels, nuclear or biomass.

*Conservation in new buildings appears to require less effort and to be a more certain and speedy technological path than the production options.

Chapter III compares the national study estimates of potential conservation in new buildings to the energy savings that DOE has projected for the BEPS program. CECA concludes the following:

*BEPS has fallen short by failing to encourage sufficient conventional conservation and by totally neglecting the potential contribution of solar energy.

*Due to structural imperfections in the market for new buildings, it is doubtful that optimum energy choices will ever result from the operation of market forces.

RECOMMENDATIONS OF PART 1:

*A mandatory program of energy performance standards is necessary to ensure energy conservation in new buildings.

*A strict set of standards is necessary to ensure the levels of conservation that are readily achievable in new buildings and vital to a brighter energy future.

Part 2: Technical and Economic Issues in Energy Budget Setting

Chapter IV shows that in analyzing conventional conservation techniques DOE has set arbitrary limits on the options that could be considered in the economic analysis. As a result:

*DOE has failed to discover the true economic optima for many of the buildings that it analyzed.

*Greater amounts of insulation are economically justified than DOE's results show.

Chapter V shows that DOE has failed to evaluate properly the potential contribution of solar energy to conservation.

*The set of assumptions about building design and owner behavior, under which the analysis of solar energy was conducted by DOE, is unrealistic and biased against solar energy.

*CECA's analysis of solar energy demonstrates that using assumptions which are realistic leads to decreased levels of energy consumption up to 35 percent below nominal BEPS. These reductions could amount to $16,000 in savings.

Chapter VI demonstrates the deficiencies in DOE's analysis of commercial buildings.

*The exercise in which a small number of buildings were redesigned according to a mid-1970's conception of energy conservation is not adequate for discovering "maximum practicable improvement in energy efficiency."

*DOE did not conduct a full life cycle cost analysis of all commercial buildings and in those few cases where life cycle cost analysis was carried out, it showed that much more conservation would be cost-justified.

*CECA shows that DOE has underestimated the cost-justified investment in conservation by 100 percent.

Chapter VII shows that DOE's estimates of fuel prices are extremely low.

*DOE has underestimated the present value of fuel and, therefore, the economic value of conserving fuels, by as much as 100-200 percent.

*CECA demonstrates that, if realistic fuel price estimates are applied to the economic analysis of the conservation options considered by DOE, just about every option becomes cost-justified, including active solar systems.

Chapter VIII demonstrates that DOE's approach to the choice of fuels, expressed in its decision to use weighting factors, seriously detracts from the BEPS program.

*It confuses the long-term goal of national energy conservation with other (frequently shifting) policies involving the choice of fuels.

*It creates problems of equity in terms of the space conditioning energy that individuals are allowed to consume.

*It optimizes the construction of buildings around very uncertain relative fuel prices which makes it unlikely that maximum improvement in energy efficiency over the life of the building will be achieved.

*As a practical matter, weighting factors cannot be sufficiently fine-tuned to keep pace with changing prices.

*It allows the fuel system, which can be changed or modified relatively easily, to dictate the design of the building envelope, which is relatively permanent.

RECOMMENDATIONS OF PART 2:

*LCC analysis should be performed without restrictions for both residential and commercial buildings in order to identify true economic optima.

*DOE should pursue LCC analysis so that results which reflect realistic differences between climates are achieved.

*DOE must consistently apply the assumption that consumers behave rationally.

*In the analysis of solar energy the full range of possibilities must be explored and realistic assumptions must be used in order to define properly the potential contribution of solar energy.

*In setting energy budgets, DOE should equalize benefit/cost ratios across geographic locations.

*BEPS must optimize solar energy in order to maximize the future retrofit potential of buildings.

*DOE's fuel price estimates need to be completely revised to reflect recent events and realistic projections of future trends.

*Weighting factors should be abandoned and BEPS should require energy efficient buildings without regard to fuel choices.

Part 3: Legal, Social and Institutional Issues in the BEPS Program

Chapter IX examines DOE's research and decision-making process from a legal point of view.

*CECA finds that the proposed rule is legally deficient because DOE has failed to document its conclusion that the limited capabilities of design professionals, equipment manufacturers and builders would prevent the rapid introduction and use of certain technically feasible energy saving technologies.

*DOE has misinterpreted "maximum practicable" by placing excessive weight on economic as distinguished from technical considerations.

Chapter X examines the impact of BEPS in a variety of environmental, economic and social areas.

*CECA agrees with DOE's conclusion that the program will have a salutory effect on outdoor air quality and that the program will not have a negative economic effect even though, as formulated, BEPS will not achieve the maximum possible economic benefits.

*Social and institutional impacts of the program may cause some inconvenience, but this minor impact is far outweighed by the benefits the program will achieve.

*CECA believes that the potential negative effect of low infiltration rates in residential buildings should be a matter of serious concern and careful study.

Chapter XI examines some of the difficulties involved in the implementation of BEPS.

*DOE's decision to issue the standards without defining a specific implementation process makes comment extremely difficult and places the whole program in jeopardy.

*DOE's reliance on sophisticated computer analysis is totally out of step with the reality of the construction industry.

Chapter XII outlines a methodology that can be utilized to study the limits of "practicability" (including social and institutional obstacles and impacts) in a systematic fashion.

*CECA's proposed methodology will test the validity of the specific concerns which have led DOE to mandate less energy conservation than is technically feasible and economically justified.

*CECA's methodology requires the participation of groups actually involved in the new buildings sector; it generates detailed descriptions of specific problems; and it points toward solutions to those problems.

RECOMMENDATIONS OF PART 3:

*In order to achieve statutory goals and comport with rulemaking requirements, BEPS must be considerably strengthened.

*Low air infiltration approaches to energy conservation should be included in BEPS, but these strategies should require air exchangers in order to guard against potential negative health impacts resulting from declining indoor air quality.

*A simplified method for calculating energy budgets for small buildings must be developed.

*A combination of the prescriptive and performance approaches can and should be developed to set conventional and solar strategies for conservation on an equal footing.

*For complex buildings DOE should rely more on state building code practices to define which buildings require a performance approach to energy budget calculations.

*The legal, social and institutional impacts of BEPS must be studied through a systematic methodology which can discover the true limits of practicability and can provide information for solving practicability problems.

Part 4: An Alternative Approach to Building Energy Performance Standards

Because CECA believes that criticism should be constructive, Chapter XIII presents an alternative approach to the BEPS analysis, which includes a framework for making and coordinating decisions about the establishment of standards.

*The conceptual framework balances five sets of factors -- technology, economics, social goals, practicability and national value calculations.

*Taking all factors into account, CECA finds that neither technology nor economics present real constraints to energy conservation and the problems of practicability are likely to be solved over time to allow periodic upgrading of the standards.

*CECA projects that by the year 2000, the average house can be built to use energy at the level at which super-efficient houses consume energy today.

Chapter XIV presents a detailed scenario for setting energy budgets for the next twenty years. This chapter embodies CECA's final recommendations for the program:

*Initially BEPS should be set 30 percent stricter than the nominal level proposed by DOE.

*Energy budgets should be reduced by 15 percent every 5 years according to an explicit timetable.

*By the year 2000 energy savings according to this scenario would be greater than 30 quads, which is the equivalent in BTU's of more than 5 billion barrels of oil. In the year 2000 the savings would be equivalent to 2.7 million barrels per day.

*CECA believes that this level of energy savings is a reasonable goal for the year 2000 and that the scenario we have proposed for the BEPS program to arrive at it is entirely practicable.

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CHAPTER I

AN OVERVIEW OF THE CONSUMER ENERGY COUNCIL OF AMERICA'S ANALYSIS OF BEPS

A. Introduction

The Consumer Energy Council of America (CECA) has been involved in the Department of Energy's rulemaking process on Building Energy Performance Standards (BEPS) for over a year. Under a grant from the Department of Energy (DOE), CECA has undertaken two sets of activities. One set of activities involved efforts to generate public participation in the BEPS rulemaking process. These activities included 1) contacting consumer groups and private citizens across the country; 2) conducting educational seminars for consumers and other individuals in 7 cities (Washington, D.C., Boston, New York, Atlanta, Minneapolis, Des Moines and San Francisco); and 3) providing technical assistance to potential witnesses in the preparation of comments. As a direct result of these activities, CECA expects more than 40 consumers to testify in person at the hearings and more than 75 consumers to file written comments with DOE.

The second set of activities involved analysis of and comment on the proposed rule. These activities included 1) a critical review conducted by CECA staff of the methodology used in the BEPS analysis; 2) independent studies conducted by CECA's staff of technical, economic and social issues in the setting of energy budgets; 3) analysis by a CECA subcontractor, the National Center for Appropriate Technology (NCAT), of potential solar energy contributions to energy conservation in new buildings; 4) analysis by the Madison Consulting Group (MCG) of fuel price projections and their impact on the BEPS economic analysis and 5) examination of the legal issues by CECA's general counsel. The results of these activities are detailed in this report.

This introductory chapter provides a brief overview of CECA's report. It describes the overall report, gives a synopsis of the findings and presents final recommendations. It is important to stress CECA's support for the concept of mandatory building energy standards and the performance principles for the standards. We take very seriously the mandate of Congress to develop standards "designed to achieve maximum practicable improvement in energy efficiency and increases in the use of nondepletable sources of energy." 1/ Indeed, as America's energy outlook has grown steadily worse, this strong language has proven to be extremely forward looking.

1/ Energy Conservation Standards for New Buildings Act, 42 U.S.C., §. 6831 et sec. (Hereafter referred to as Energy Conservation Standards Act or ECSNBA).

We are nonetheless critical of DOE's research on many points because we believe that DOE has been much too timid in its approach to the standards. We recognize the magnitude and complexity of the task which DOE has undertaken and the fact that a large number of decisions and assumptions had to be made in order for the analysis to proceed. Most of the decisions regarding the proposed standards were made several years ago and DOE took the most cautious position possible in setting the standards. Whether DOE feared that the design and construction industries would be unable to adjust to changing energy use requirements or that consumers would be unwilling to make the necessary investments in conservation, events have moved so quickly that these fears are no longer justified.

Energy conservation has become a primary national goal. Further, a great deal more conservation than DOE was willing to suggest has now become economically justified. The technical and institutional factors which DOE cited in its proposed rule as obstacles to achieving greater energy conservation have been rendered insignificant compared to the benefits of more conservation and the urgency of the energy situation. Our criticism of DOE's research is simply intended to improve research conducted in the future and to convince DOE and others that more conservation is socially desirable, technically possible and economically beneficial in the present.

B. Part 1: New Buildings and National Energy Options: The Program in Perspective

In this part CECA analyzes the role that new buildings in general and BEPS in particular can be expected to play in America's energy future. We believe that under the current crisis situation it is important at the outset to have a general overview of alternative energy programs and possibilities. As analysts become overwhelmed by specific aspects of BEPS, they tend to lose sight of the overall program. Part 1 is intended to guard against this danger.

1. Chapter II: New Buildings as a Source of Energy

Chapter II begins with a review of a series of major national energy policy studies published in the last year or two. From these studies we extract estimates of the potential contribution that each of 25 energy options can make to the nation's energy resources. For conservation options, we are accepting the current conception that runs roughly as follows: a BTU (British Thermal Unit) of energy saved is a BTU of energy earned, equal in importance to a BTU of energy produced.

We find that new buildings can save a great deal of energy. In fact, their contribution to national energy resources can be greater than any other conservation option (except conservation in automobiles in the near term) and equal to the average contribution of all the production options. This contribution does not appear to require Herculean efforts or major technological breakthroughs.

In fact, it appears to require less effort and to be a more certain technological path than the production options.

CECA concludes that conservation in general and conservation in new buildings in particular should play a major role in America's energy future and deserves attention and funding equal to any other energy policy option.

2. Chapter III: Building Energy Performance Standards

Having determined what the national studies project for conservation in new buildings, in Chapter III CECA compares these projections to the contributions to energy conservation that BEPS would achieve. We find that the nominal standards fall far short of even the low projections of energy conservation contained in the national studies. A brief analysis of the aggregate estimates of potential energy conservation suggests that BEPS has fallen short in two areas: 1)it has failed to encourage sufficient conventional conservation and 2) it has totally neglected the potential of solar energy.

Chapter III concludes with a discussion of the reasons why a mandatory program of energy performance standards is necessary to ensure conservation in new buildings. A number of imperfections in the market structure for new buildings and in the pattern of decision-making in the purchase of buildings are cited as obstacles to rapid changes in this sector. We conclude that it is doubtful that optimum energy conservation choices will ever result from the operation of market forces in the new buildings sector and that the likelihood is for a slow, suboptimal adjustment toward better energy decisions. This slow adjustment will result in minimal energy savings and the build-up of a stock of energy inefficient structures, a situation which neither the nation as a whole nor consumers as individuals can tolerate.

Therefore, we conclude that mandatory energy performance standards are necessary in order to ensure that significant conservation in new buildings will take place. Since standards set at the nominal BEPS level are not adequate to achieve even the minimum conservation that most studies project for new buildings and standards set at DOE's strict level would barely achieve that minimum, we recommend that much stricter standards than DOE has proposed be implemented. Further, in order for the buildings sector to make moderate to high level contributions to national energy resources, the vast potential of solar energy must be incorporated into BEPS.

C. Part 2: Technical and Economic Issues in Energy Budget Setting

In this part we examine those aspects of DOE's methodological approach and data base which led it to call for less conservation than it could easily have recommended. We find a series of conscious choices and methodological weaknesses that seriously underestimate the value of and potential for conservation.

1. Chapter IV: Setting Residential Energy Budgets

Chapter IV shows that in analyzing conventional conservation techniques (essentially additional insulation and glazing) DOE's arbitrary limits on the options that could be considered have distorted the life cycle cost analysis. Due to these limits, many economic optima were not achieved and the sensitivity analysis was misinterpreted. We show, at a minimum, that greater amounts of insulation are economically justified and that DOE's interpretation of the results of its own analysis is skewed to hide this fact.

CECA recommends that LCC analysis be performed with reasonable assumptions about the behavior of the occupants of a building and without restrictions on the conservation options considered. Only in this way can true economic optima be identified. In setting energy budgets, DOE should ensure results that reflect realistic differences between climate zones and minimize differences in benefit/cost ratios between different geographic locations.

2. Chapter V: Potential Contribution of Solar Energy to Residential Space Heating

In Chapter V the argument is made that DOE has shown a general indifference, even hostility, to solar energy. This attitude has led it to seriously underestimate solar energy's potential contribution to residential space heating and its cost-effectiveness. The set of assumptions about building design and owner behavior under which the analysis of solar energy was conducted by DOE is unrealistic and made it impossible to discover the true potential of solar energy. Drawing from Appendix II, which contains the NCAT analysis of passive solar energy and increased levels of insulation, we show that simple modifications in assumptions reveal considerably greater energy conservation and economic benefits than DOE estimated.

We argue that the mandate for maximum use of renewables would require DOE to conduct a thorough solar analysis which would examine fairly all of the problems and potential of solar energy use in new buildings. Only on the basis of such an analysis can informed choices be made.

We also point out that in order to achieve maximum improvement in energy efficiency over the full life of a building, DOE should establish standards that give greatest emphasis to passive solar conservation techniques. The reasoning is as follows: 1) Over the 60 year life of a building, we must expect that one or more retrofits will be necessary. 2) Passive solar techniques are the most difficult to retrofit. 3) If one meets BEPS with passive techniques in the present, it will be easier to add other conservation techniques in the future than vice versa. 4) Therefore, the likelihood is greater that buildings which start with passive solar techniques will end up with better overall energy efficiency than buildings which start with some other technique. Thus, both aims of Congress' mandate to DOE -- to achieve increased use of renewable sources of energy and to achieve maximum improvements in energy efficiency -- would be best served by encouraging the use of passive solar techniques.

3. Chapter VI: Setting Energy Budgets for Commercial Buildings

Chapter VI demonstrates the deficiencies in DOE's analysis of commercial buildings. The exercise in which a small number of buildings were redesigned according to a mid-1970's conception of energy conservation is not adequate for discovering "maximum practicable improvement in energy efficiency." Further, the small sample of buildings is faulty. In addition, DOE did not conduct a full life cycle cost analysis of all commercial buildings. In those few cases where life cycle cost analysis was carried out, it showed that much more conservation is cost-justified.

CECA shows that DOE has underestimated the cost-justified investment in conservation by an average of 100 percent, even using its own, outdated price estimates for fuels. We recommend that DOE conduct full life cycle cost analysis on all types of commercial buildings and set the energy budgets at the optima identified by economic analysis conducted with realistic price estimates.

4. Chapter VII: The Impact of Fuel Price Increases on the Value of Energy Conservation

Chapter VII draws from Appendix I (the study of fuel prices; and finds that DOE's estimates of fuel prices are extremely low, leading it to undervalue the benefit of conservation by as much as 100-200 percent. We show that if realistic fuel price estimates are applied to the economic analysis of the conservation options considered by DOE, just about every option becomes cost-justified, including active solar systems. In light of these findings, it is evident that the energy budgets should be reduced so that the wide range of cost-justified conservation options which DOE has neglected will come into widespread use.

5. Chapter VIII: Weighting Factors and Fuel Choices

Finally, Chapter VIII makes the case that DOE's approach to the choice of fuels, expressed in its decision to use weighting factors, seriously detracts from the BEPS program. It confuses the long-term goal of national energy conservation with other (frequently shifting) policies involving the choice of fuels. It creates problems of equity in terms of the space conditioning energy that individuals are allowed to consume. It optimizes the construction of buildings around a very uncertain factor -- relative fuel prices -- which makes it unlikely that maximum improvement in energy efficiency over the life of the building will be achieved. As a practical matter, we believe that weighting factors cannot be sufficiently fine-tuned to keep pace with changing prices. Finally, after adjusting for recent price trends and other social considerations, we find that price differences between fuels have become irrelevant from the national point of view of encouraging or discouraging the use of any particular fuel. For these reasons, we conclude that weighting factors should be abandoned.

D. Part 3: Legal, Social and Institutional Issues in the BEPS Program

In this part CECA examines the social considerations that DOE has taken into account in setting BEPS and concludes, once again, that DOE has underestimated what can and should be done in order to conserve energy.

1. Chapter IX: Legal Issues

Chapter IX examines DOE's research and decision-making process from a legal point of view. CECA finds that in the proposed rule DOE has not merely reduced the energy savings which could be achieved through BEPS, but also has issued a proposed rule which is legally deficient. BEPS was limited in energy saving effect largely because of a conclusion on the part of DOE that the limited capabilities of design professionals, equipment manufacturers and builders would prevent the rapid introduction and use of certain technically feasible energy savings technologies. This conclusion not only lacks a substantial underpinning of evidence, but lacks any evidentiary base at all. Under the laws governing federal rulemaking, a regulation must be based on substantial evidence. The limitations on BEPS related to the presumed incapacities of the building industry lack the requisite evidentiary basis and are therefore legally deficient.

Similarly, under its authorizing legislation, BEPS must be designed to achieve "maximum practicable" energy savings and utilization of nondepletable energy sources. DOE has misinterpreted "maximum practicable" by placing excessive weight on economic as distinguished from technical considerations. DOE also has produced a rule which, in actuality, will achieve no increased nondepletable energy source use and may instead decrease such use.

The proposed rule is, accordingly, legally deficient not only as a matter of policy and prudence but of law as well. BEPS must be considerably strengthened beyond the levels set forth in the proposed rule if it is to achieve statutory goals and comport with rulemaking requirements.

2. Chapter X: Environmental Impact

Chapter X examines the impact of BEPS in a variety of environmental, economic and social areas. CECA agrees with DOE's conclusion that the program will have a salutary effect on outdoor air quality and that the program will not have a negative economic effect, even though, as formulated, it will not achieve the maximum possible economic benefits. We also conclude that the social and institutional impacts of the program may cause some inconvenience, but this minor impact is far outweighed by the benefits the program will achieve.

The central focus of Chapter X is the issue of indoor air quality. CECA believes that the potential negative effect of low infiltration rates in residential buildings should be a matter of serious concern and careful study. We review the existing institutional and informational gaps in this area and note with alarm that infiltration rates are currently being lowered in spite of this lack of information (in Appendix III we conduct a brief review of the health and safety-related reasons why low infiltration rates should not be achieved without close regulation). We recommend that air exchangers -- a low-cost, mechanical device growing rapidly in popularity abroad -- be required in any low infiltration approach to energy conservation.

3. Chapter XI: Implementation

Chapter XI examines some of the difficulties involved in the implementation of BEPS. CECA finds DOE's decision to issue the standards without defining a specific implementation process extremely troubling. Implementation is too vital an aspect of the program to have been neglected until the last moment and we believe that significant changes will be necessary in the standards if they are to be applied effectively.

Specifically, we suggest that a simplified method for calculating energy budgets for small buildings be developed. As DOE's conception of implementation now stands, it will create an outright disincentive to the use of renewable resources. Because individuals choosing solar or other renewable energy sources are forced to use a costly and complex performance approach, while those using conventional approaches to conservation will have access to relatively simple prescriptive codes, renewable energy sources will be placed at a disadvantage. We believe that a combination of prescriptive and performance approaches, as in the Florida State Code, Section 9, should be developed. The computer approach to design certification, which DOE seems to favor, is completely out of touch with the reality of the home building industry.

For complex buildings we argue that DOE will have to rely more on state building code practices to define which buildings require a performance approach to energy budget calculations. This approach is likely to rely heavily on certification by licensed professionals. We argue that the issue of liability can be readily handled by existing practices and should provide no obstacle to the issuance of the standards.

4. Chapter XII: A Methodology for Assessing Practicability

Chapter XII suggests a methodology that can be utilized to study the limits of "practicability" (including social and institutional obstacles and impacts) in a systematic fashion. Since DOE has set the level of BEPS almost entirely on the basis of considerations of practicability, careful evidence should have been provided to document the specific concerns which have led DOE to mandate less energy conservation than is technically feasible and economically justified. No such analysis was carried out. The methodology which CECA proposes requires the participation of groups actually involved in the new buildings sector; it generates detailed descriptions of specific problems; and it points toward solutions to those problems. Thus, it provides an evidentiary basis for making decisions and a guide to areas where resources should be applied to achieve greater conservation.

E. Part 4: An Alternative Approach to Building Energy Performance Standards

Because we believe that criticism should be constructive, Part 4 presents an alternative approach to the BEPS analysis.

1. Chapter XIII: An Alternative Framework for Policymaking

Chapter XIII sets out a clearly defined conceptual framework for making and coordinating decisions about the establishment of building energy performance standards. The conceptual framework balances five sets of factors -- technology, economics, social goals, practicability and national value calculations. Each set of factors is defined and described in a rigorous life cycle cost framework. CECA then develops an estimate of the actual juxtaposition of these sets of factors as they affect the potential for energy conservation in new buildings. We show that neither technology nor economics present real constraints to energy conservation and that there is no need to adjust fuel prices artificially to take social goals into account (recent and projected real price increases are enough to do the job).

With the decision on BEPS resting squarely on the weight of practicability concerns and national value calculations, CECA argues for an approach which (adjusted for climate zones) creates maximum equity among individuals in the amount of energy allowed for space conditioning and minimizes differences between individuals in benefit/cost ratios, while assuring as much conservation as possible.

2. Chapter XIV: Selecting a Sensible BEPS Scenario

On the basis of the conceptual framework and the empirical results derived from it in Chapter XIII, CECA recommends that the initial energy budgets be set at a level of energy use which is roughly 30 percent below nominal BEPS. This point seems technically feasible, economically justified and practicable. If set at this level there would be a range of cost-effective options available to builders to meet the standards.

Moreover, over time we expect technology to improve and problems of practicability to be solved so that the standards can be systematically upgraded. Indeed, we suggest that DOE set a specific timetable -- a 15 percent reduction in the level of energy use every five years -- which would serve to ensure that rapid progress is made.

We project that by the year 2000, the average house can be built to use energy at the level at which super-efficient houses today consume energy.

Further, in reviewing the impact of this scenario on behavior in the new buildings market we conclude that it would have a positive effect in encouraging the rapid spread of existing, cost-effective, energy-conserving technologies, while it should have no negative impact on the development of new technologies. Incentive would still exist for achieving the maximum level of energy use at lower cost, (or achieving lower levels of energy use at lower life cycle cost) through technological improvements and design advances. The impetus to rational optimization of energy use would, in fact, be greatly reinforced by this approach to the standards.

We estimate that by the year 2000 the equivalent of almost three million barrels of oil per day could be saved annually as a result of this scenario. The cumulative savings between 1980 and 2000 would be more than 30 quads, which is the equivalent of more than 5 billion barrels of oil.

F. Conclusion

While CECA is critical of the DOE research in many respects, we believe that it contains sufficient evidence to support a much stricter standard than has been proposed. This, coupled with our independent analyses which show that a great deal of conservation is cost-justified and feasible, leaves little doubt that the standards should be strengthened before they are issued in final form. Once an initial, reasonably strict standard is in place, DOE should go back to the drawing board and reconsider its overly cautious approach, explore the higher levels of conservation that can be achieved in the coming decades and develop new standards for future years to achieve these levels.

Part One:

NEW BUILDINGS AND NATIONAL ENERGY OPTIONS: THE PROGRAM IN PERSPECTIVE

CHAPTER II

NEW BUILDINGS AS A SOURCE OF ENERGY

A. The Justification for Conservation

In August 1976, when Congress passed the Energy Conservation Standards for New Buildings Act, America's energy future looked ominous and Congress chose to use strong language to make that point.

> The Congress finds that ...Large amounts of fuels and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings because such buildings lack adequate conservation features...
>
> The purposes of this title, therefore, are to...provide for the development and implementation, as soon as practicable, of performance standards for new residential and commercial buildings which are designed to achieve maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy... 1/

This strong language must be kept in mind as we review the actual Building Energy Performance Standards (BEPS), which the Department of Energy (DOE) issued in the form of a Notice of Proposed Rulemaking (NOPR) in November 1979. America's energy future now looks even more ominous and CECA believes that the intention of Congress to conserve energy ought to be interpreted in the strongest manner possible.

1/ Energy Conservation Standards Act.

CECA is not the only organization which places this great emphasis on conservation. Recently, two of the nation's most prestigious research institutions reached a similar conclusion. As the Report of the Energy Project at the Harvard Business School argued:

> We have already discussed the substantial difficulties and very considerable social costs that attend increasing dependence on foreign oil, the limited productive capacity of domestic oil and gas, and the high uncertainties of increased reliance on coal and nuclear. Conservation may well be the cheapest, safest, most productive energy alternative readily available in large amounts. By comparison, conservation is a quality energy source. It does not threaten to undermine the international monetary system, nor does it emit carbon dioxide into the atmosphere, nor does it generate problems comparable to nuclear waste. And contrary to the conventional wisdom, conservation can stimulate innovation, employment, and economic growth. 2/

A study by the Ford Foundation echoed this sentiment:

> Three considerations lead us to the conclusion that energy conservation investments should be treated more generously in a contest for public support.
>
> First, energy conservation can buy time for the Nation in a swift way. Unlike other supply sources that may take a decade or two to bring on line, energy from conservation can in many cases be "produced" quickly and economically from millions of "decentralized" sources.

2/ Robert Stobaugh and Daniel Yergin, Energy Future: The Report of the Energy Project at the Harvard Business School (New York: Random House, 1979)p. 137. Hereafter referred to as Energy Future.

Second, energy conservation has economic advantages that are hard to find so well packaged in any other energy resource. By its nature, spending on energy conservation is mostly domestic, so that no trade deficits are involved (importing efficient foreign automobiles is an exception and perhaps a transient one). Inflation is generally reduced by energy conservation investments.

Third, the sources of energy conservation tend to be environmentally benign in their application and environmentally helpful in their effects. Although there has been some concern about indoor air quality in buildings that are sealed too tightly and research has been undertaken into the possible ill effects of fiberglass, those and other possible environmental effects of conservation are minor and manageable when compared with those associated with energy production, transportation, and use and even with imports. Moreover, to the extent that energy conservation programs reduce the need for conventional energy, the ill effects engendered by the supply-transport-use chain are eliminated--or at least delayed until a future day when improved technology might further mitigate their damaging effects on health and environment.

These three effects argue in favor of energy conservation as a general national strategy. But they are powerful arguments for favoring energy conservation investments specifically at a time when a large number of energy sources are competing for federal support. Conservation, as we have defined it, yields a greater return than many of those supply alternatives currently receiving support. 3/

3/ Hans H. Landsberg, et al, Energy: The Next Twenty Years (Cambridge, Ballinger, 1979) pp. 140-141. Hereafter referred to as Energy: The Next Twenty Years.

The purpose of this chapter is to examine the potential contributions to national energy resources that conservation in new buildings can make. CECA's analysis is based on a critical reading and integration of a series of major studies of the national energy situation which were published in the past year. 4/ These documents, prepared by some of the most well-respected research institutions in the country, represent the current thinking of the intellectual community about America's energy future. However, from the point of view of the statement and implementation of actual policies, each of these studies leaves a good deal to be desired. In some cases they are framed in such general terms, in others they rely so heavily on a few specific examples, that their relevance to a real world of program implementation is limited. Thus, they provide only raw material which must be carefully remolded if it is to guide properly our judgment about what can or should be done to conserve energy.

4/ The Committee on Nuclear and Alternative Energy Systems, National Research Council, *Energy in Transition, 1985-2010*, (National Academy of Sciences, Washington, D.C.: 1979): Hereafter referred to as *Energy in Transition*; Sam Schur, *et al.*, *Energy in America's Future: The Choices Before Us*, (Resources for the Future/Johns Hopkins University Press: Baltimore:1979): Hereafter referred to as *America's Energy Future*; Industrial Union Department, *Energy for Working America* (Draft, Washington, D.C., 1980): Hereafter referred to as *Working America*; Vince Taylor, *Energy: The Easy Path*, (Union of Concerned Scientists, Cambridge: 1979): Hereafter referred to as *The Easy Path*; *Energy Future*; *Energy: The Next Twenty Years*.

In sum, this chapter establishes the rationale for the BEPS program, not in its legislative terms, but in its policy implications. Legally, the Congress has mandated conservation; realistically, it remains to be seen what can be accomplished.

B. Energy Use in New Buildings

In order to understand the landscape of America's energy future which the leading thinkers in the field are painting and to locate the position of new buildings within that landscape, we must divide the various supply and demand estimates into their constituent parts. Since most of the estimates are in global terms, we must also pay careful attention to the specific role being played by each variable in the energy equation. Without pinning down the specifics, one has no way of judging how realistic the estimates are.

Moreover, since most estimates involve some assumptions about increased efforts at conservation and/or production -- that is, they are based on expected or proposed policy-related efforts to change the national energy future -- it is important to examine the estimates in relationship to one another. In this way, we gain some feel for just how much extra effort is being assumed or included or expected from each aspect of the energy picture.

Thus, though the central focus of this report is on the energy performance of the envelope (or shell) of new buildings, this chapter also develops estimates for the other components of the building, such as appliances and equipment, as well as for the components of the transportation sector, of the industrial sector and of a variety of production options. The goal is to gain a complete understanding of what is expected and being asked by BEPS of the new buildings sector in the context of overall policy options.

In order to arrive at an estimate of the contribution of the envelope of new buildings we must break the existing estimates of energy conservation into a number of constituent parts. To do so, we must answer a series of questions:

1. How is energy used in buildings?
2. How quickly will energy conservation in the various elements of buildings be effectuated?
3. How quickly will new buildings be built?

By moving through these three steps, we can estimate how quickly the shell component can contribute to overall conservation in the buildings sector.

1. Energy Use in Buildings

In Table II-1, we present two estimates of energy use in buildings in the mid-1970's. It can be

TABLE II-1

DISTRIBUTION OF ENERGY USE
(In %)

	Residential*	Residential**	Commercial**
Space Heat	53	51	35
Water Heat	14	15	5
Air Conditioning	7	7	14
Refrigeration	5	8	7
Other	21	19	39

Sources:

* Energy Future, page 166.

** America's Energy Future, Table 2-3, page 75.

best copy available

seen that for residential energy use, space heating, air conditioning and the heating of water account for roughly 75 percent of the energy consumed in buildings. In the commercial sector, these three elements account for somewhat less energy, about 54 percent. 5/ These three areas of energy use -- space heat, air conditioning and water heat -- are the three areas with which the Building Energy Performance Standards are concerned.

However, the building shell alone is not responsible for all energy to be conserved in these three areas. There is a great deal of energy loss and, therefore, potential energy savings associated with the equipment and appliances that are used to heat or cool the building or heat the water. BEPS does not deal with this aspect of energy use or conservation. Guestimates of the distribution of potential energy conservation between the equipment and the shell of buildings are few and far between. The best indications are that the division is roughly 50-50.

For example, a study by the Office of Technology Assessment indicates that the relationship between incremental savings in energy consumption for insulation and a heat pump is, on average, a one-to-one

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5/ See Table II-1.

relationship (see Table II-2).[6] While this would suggest that, after other appliances are included, the shell is less important than equipment, it should be kept in mind that the heat pump constitutes a very great improvement over resistance heating efficiency. Another study suggests an average ratio of 1:2.5 between furnace and shell.[7] Recently cited figures place the heating, ventilation and air conditioning contribution to conservation at 30 percent.[8]

Thus, CECA's analysis assumes that one-half the conservation attributed to the buildings sector will come from improvements in the shell, the other half will come from improvements in equipment and appliances. We make this assumption explicit so that should contrary evidence be developed, all subsequent estimates could be adjusted, either up or down, in a very straightforward manner.

2. Rate of Improvements in Building Elements

The next question we must ask is how quickly improvements in each of these elements of a building are expected to occur. If one element is expected to improve

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[6] Residential Energy Conservation (Office of Technology Assessment, Washington, D.C., 1979), p. 50: Hereafter referred to as Residential Energy Conservation.

[7] Working America, pp. 47-49.

[8] Washington Post, Real Estate Section, March 7, 1980.

TABLE II-2

INCREMENTAL SAVINGS IN ENERGY WITH A CONVENTIONAL ELECTRIC HOUSE AS A BASE
(percent energy reduction)

	Chicago	Baltimore	Houston	Average
Insulation	67	49	23	46.3
Heat pump	71	65	10	48.7

Source:

Residential Energy Conservation, Table 15, page 50.

much more quickly than another, the long run contribution of that element of the building to energy conservation would be considerably higher.

a. Shells Versus Equipment and Appliances

The figures in Table II-3 do not suggest a great difference between the expected improvement of thermal integrity (the shell) and equipment. While air conditioning and electric hot water have somewhat greater prospects for improvement in energy intensity than thermal integrity, gas and oil heating (by far the majority source of heat) have somewhat dimmer prospects. (This is the reason that the heat pump embodies such a comparatively high rate of improvement.) On balance, then, we will assume a roughly equal rate of improvement between equipment and shell.

These figures are important from another point of view, for they tell us how quickly change is expected to occur. Taken together, they establish a reasonable range for expectations.

As Table II-3 shows, the National Academy of Sciences (NAS) projects an average rate of improvement of between 10 and 40 percent for building shells and between 0 and 42 percent for equipment and appliances. The Resources for the Future (RFF) study predicts a rate of

TABLE II-3

PERCENTAGE IMPROVEMENT IN ENERGY INTENSITY IN BUILDINGS

A. 1978-2010 improvement*

	Moderate	High
Thermal Integrity		
Residential	10	10
Commercial	14	40
Government & Educational	10	30
Space Conditioning		
Air	20	30
Electric Hot Water	30	42
Gas and Oil	6	10
Refrigeration	24	37
Utility	0	14

B. HVAC + Shell 1970-2000 improvement**

Retrofit	25[a]	28[b]	39[c]	64[d]
New	39[b]	48[c]	50[a]	77[d]

Sources:

* Energy in Transition, Table 2-4, pages 114-115.

** America's Energy Future, Table 5-2, page 141, all calculated with the base of Row F, a=Row 5, b=Row 4, c=Row 2, d-Row 3.

improvement for both elements combined of between 25 and 77 percent. The differences between the two sets of figures are probably not as great as they seem. A large part of the difference between the first set and the second set would be explained by improvements that occurred between 1970 and 1978. The HVAC (heating, ventilation and air conditioning) and shell estimates for 1970-2000 incorporate the easy changes that occurred between 1970 and 1978 and one would expect the rate of improvement to slow down for the later period, 1978-2010.

b. New Versus Old Buildings

The figures also show a clear expected advantage of new buildings over old buildings, with energy efficiency in new buildings expected to improve roughly 60 percent faster than old buildings. This reflects the difficulty of retrofit. Thus, in any weighting scheme in which improvements in the total buildings sector need to be apportioned between new and old buildings on the basis of the rate of improvement, one should give roughly 60 percent more weight to new buildings.

3. Rate of New Building Construction

The final question we must ask is how quickly new buildings will come on line to effect energy conservation in the buildings sector. The housing stock turns over at a notoriously slow pace, as Table II-4 suggests. By the year 2000, less than half of the single family units and only 61 percent of the multi-family units will have been built since 1975. This is a turnover rate of roughly 2 percent per year.

We believe that this estimate, based on historical patterns and moderate assumptions about population growth and demographic changes, may be too low. The fundamental propositions underlying all of the studies reviewed here is that energy will become a more important and more troublesome commodity over time. If that is the case, then we would expect old, energy inefficient buildings to be retired more quickly than historical rates suggest.

We are not suggesting a massive abandonment of homes (although the experience with automobiles suggests that considerable upheavals can occur) but a slow and persistent process. For example, there were 70 million homes in the United States in 1975 and the figures cited in Table II-4 suggest 51 million of them would still be in existence in 2000. That is 27.1 percent of the stock, or 1.085 percent per year. That works out to 759,000 units per year. Suppose an additional one-tenth of one percent of the housing stock were abandoned per year, i.e., an increase in the rate of retirement of 1.185 percent, which

TABLE II-4

ESTIMATED COMPOSITION OF THE HOUSING STOCK; YEAR 2000

	Million Units		Percent Distribution with Categories		Percent Distribution of Total Units	
	Existing 1975	New Since 1975	Existing 1975	New Since 1975	Existing 1975	New Since 1975
Single Family	36	32	53	47	32	28
Multi-Family	15	23	39	61	13	20
Mobile	0	7	0	100	0	6

Source:

America's Energy Future, Table 5-1, page 12.

is 70,000 additional homes per year. Such a slight change would reduce by two million the number of homes existing in the year 2000 which had existed in 1975. This would result in a consequent increase of the share of new buildings to total housing stock in the year 2000.

While we believe that this process of retiring the old building stock more rapidly will occur, we have no way of estimating how great its effect will be. We point it out only to suggest that by using the rate of turnover implied in Table II-4, we are using a conservative estimate. Alternative estimates of the rate of turnover would necessitate a very simple and straightforward modification of the estimates.

C. Calculating the Role of Building Shells in Conservation

Having made estimates of the relative importance of each element of the building to energy use and having made estimates of the potential rate of improvement in each element, we can now estimate the relative importance of the constituent elements within the buildings sector (see Table II-5). The estimates of conventional energy saved have been the object of the previous discussion. HVAC is seen as a constant 30 percent of the total; appliances are set at a constant 20 percent of the total. The distribution of the contribution of shells, between retrofit and new, is

TABLE II-5

DISTRIBUTION OF INCREMENTS OF SAVED ENERGY OVER TIME AND BETWEEN ASPECTS OF THE BUILDING COMPOSITION
(In percent of total)

	1990			2000			2010		
	Conventional	Passive Solar	Active Solar	Conventional	Passive Solar	Active Solar	Conventional	Passive Solar	Active Solar
HVAC	30	—	—	30	—	—	30	—	—
Appliances	20	—	—	20	—	—	20	—	—
Retrofit Shell	31	—	50	13	—	13	7	—	5
New Shell	19	100	50	37	100	87	43	100	95

Source:

CECA estimate.

arrived at by multiplying the share of new houses in the stock at any point in time by the inverse of the ratio of the expected improvement in energy use at the same point in time:

$$\frac{\text{New Houses}}{\text{Total Stock}} \times \frac{\text{Energy Improvement of New Houses}}{\text{Energy Improvement of Old Houses}}$$

This gives us the weighted average contribution of new building shells to conservation through conventional means.

However, since each of the studies reviewed generally counted solar energy for domestic use as part of the solar production option rather than the conservation option, we must calculate a separate estimate for the contribution of solar energy to energy conservation in new buildings.

The solar components have no history on which to base projections. To keep matters simple, we have assumed that all passive solar and one-half of the active solar contributions to conservation in the buildings sector will occur in new buildings. This may overemphasize the difficulty of retrofitting with passive solar while being too optimistic vis-a-vis retrofitting with active solar. On balance, we think it is a cautious estimate of the contribution of solar in new buildings. Again, these are simple and explicit assumptions which can easily be modified with new evidence.

We now have estimates of the percentage that each element of the new buildings sector contributes to conservation. In order to generate specific estimates of the energy saved, we must apply these percentages to the total savings projected for the sector. In order to arrive at estimates of total energy savings, one must first estimate what energy consumption would be in a given year without conservation and then suggest alternate levels of energy use assuming various conservation options. The difference between future energy use with and without conservation options has come to be defined as the contribution of conservation to national energy resources. The major national studies have specialized in making these estimates.

The energy use projections of the National Academy of Sciences study are depicted in Table II-6. We show these as an example. The NAS envisions three energy scenarios: one with business as usual; one with moderate efforts (defined as slow incorporation of measures to increase efficiency) to conserve; and one with aggressive efforts (defined as aiming at maximum efficiency plus minor life-style changes) to conserve.

Table II-6

ENERGY USE PROJECTIONS
(Conventional)
(in Quads)

	Buildings		Industry		Transportation		Total	
	Estimated Demand	Increment	Estimated Demand	Increment	Estimated Demand	Increment	Estimated Demand	Increment
1990								
Business As Usual	23.3	7.6	45.4	5.5	30.3	6.1	99	19
Moderate Conservation	15.7	9.7	39.9	7.2	24.2	11.1	80	28
Aggressive Conservation	13.6		38.2		19.2		71	
2000								
Business As Usual	27.5	8.6	53.7	5.8	35.8	6.8	117	21
Moderate Conservation	18.9	13.5	47.9	14.4	29.0	16.1	96	44
Aggressive Conservation	14.0		39.3		19.7		73	
2010								
Business As Usual	32	13.5	62.4	15.5	41.6	13.2	136	42
Moderate Conservation	18.5	17.8	46.9	22.6	28.4	21.6	94	64
Aggressive Conservation	14.2		39.8		20.0		72	

Source:

Energy in Transition. Totals by linear interpolation from Figure 1-3, page 10. Distribution proportional with the distribution in Table 2-2, page 102. Losses of energy are distributed proportionately with energy use.

The difference between the business as usual projection and the moderate scenario yields the incremental energy savings that moderate conservation policies would achieve. The difference between the business as usual projection and the aggressive scenario yields the incremental energy savings that the aggressive scenario would achieve. This total energy savings for the new buildings sector can then be apportioned between each element of the sector, i.e., as in Table II-5, for 1990, 20 percent to appliances, 30 percent to equipment, 31 percent for retrofit shells and 19 percent for new shells.

Since solar, as we noted earlier, is treated separately in the national studies, we must also generate an estimate for the solar contribution. Again, we calculate a total energy contribution from solar in the buildings sector and then apportion it between new and old buildings. Total solar estimates of the studies, as presented in Table II-7, vary widely -- a good deal more widely than the conservation options. As we shall see, the other estimates of production options also show more variation than the conservation options. This would seem to be largely a result of uncertainty about (and a wider range of variation in) the potential impact of policy -- especially in the less conventional technologies. Where the specific

Table II-7

YEAR 2000 ESTIMATES OF SOLAR USE

(in Quads)

	1	2		3		4	5	6	
	Energy Future	Working America		Transition		Congressional Quarterly	Morrow	SRI	
		Low	High	Low	High			Low	High
Total Solar (in Quads)	21.2	19.6	30.2	5.9	13.1	25.9	30	10.6	21.2
Domestic Space (Passive)		1.1	1.8	N/A	.3	N/A	N/A	N/A	N/A
Domestic Space (Active)	6.3	2.1	4.0	"	.6	"	"	"	"
Domestic Hot Water				"	1.2				
Other On-Site	4.2	4.6	6.9	"	3.4	"	"	"	"
Biomass (and other fuels)	6.3	5.7	7.4	"	5.4	"	"	"	"
Centralized Electric	—	1.6	5.3	"	2.2	"	"	"	"
Hydro Electric	4.2	4.6	4.8	"	5.0	"	"	"	"
Solar as % of Total Energy Consumption	20	N/A	N/A	6	14	23	16	7	13

Sources:

Column 1, Energy Future, p. 214.
Column 2, Working America, p. 129.
Column 3, Energy in Transition, p. 424.
Column 4, 5, 6, Energy Future, p. 211.

estimate for solar does not give a breakdown between active and passive, we have assumed the same distribution as that for the NAS Energy in Transition study.

With global estimates from a number of studies in hand, we can estimate a range of potential contributions of new building shells to energy conservation (see Table II-8). The base year for each of these estimates is either 1977 or 1978. By and large, we find fairly narrow ranges of estimates for conservation and solar. For 1990, estimates of the total contribution of new buildings ranges from 1.2 quads to 3.4 quads. This translates roughly into between 500,000 and 1.5 million barrels of oil equivalent per day. For 2000, the estimates vary from 5.4 quads to 11.9 quads and for 2010, they vary from 9.9 quads to 18.2 quads. In all cases, roughly one-half of the energy savings comes from conventional means and one-half comes from solar. Given the fact that the low estimates assume only moderate efforts at conservation and the high estimates assume aggressive efforts to conserve, the differences between the lows and the highs seem reasonable.

New envelopes start slowly as an element in total energy conservation and build rapidly over time to play a very large role. Thus, even if the estimates were off slightly in terms of the relative distribution between envelopes and equipment or between new versus old envelopes,

Table II-8

INCREMENTAL REDUCTION IN ENERGY USE IN BUILDINGS
(in Quads)

	1990			2000					2010	
	Low (1)	(2)	High (3)	Low (4)	(5)	(6)	(7)	High (8)	Low (9)	High (10)
Conventional										
Appliance	1.2		1.9	1.7		2.7			2.7	3.6
HVAC	2.3	2.1	2.9	2.6	2.1	4.1			4.1	5.3
Envelope										
Old	3.1	3.6	3.0	1.1	.9	1.8			.9	1.2
New	.7	.9	1.8	3.2	2.6	5.0			5.8	7.7
Solar										
Old	.2	.2	1.1	.3	2.1		3.0	.7	.4	.5
New	.5	.6	1.6	2.2	3.2		5.1	6.9	4.3	10.5

Sources:
Column 1, Energy in Transition.
Column 2, Working in America, in text.
Column 3, Energy in Transition.
Column 4, Energy in Transition.
Column 5, America's Energy Future, Table 6-2, p. 185.
Column 6, Energy in Transition.
Column 7, Energy Future, p. 122.
Column 8, America's Energy Future, p. 127.
Column 9, Energy in Transition.
Column 10, Energy in Transition.

it is safe to say that new buildings would play a large role within the overall sector by the year 2000. As we shall see when we look at the overall energy picture, this role is roughly equal to any other single energy option, whether conservation or production.

D. The Contribution of Other Sectors to National Energy Resources

A methodology similar to the one applied for the buildings sector can be applied to the two other major energy consuming sectors -- transportation and industrial. Since the buildings sector is the central concern of this report and since the general approach for considering buildings has been developed and demonstrated above, the same specific steps which could be applied to the other sectors will not be discussed, although they are presented in the tables below.

Tables II-9, II-10 and II-11 show the relevant steps for the transportation sector, with Table II-12 giving the actual conservation figures for each aspect of the transportation sector. Table II-13 shows the conservation figures for each aspect of the industrial sector.

Finally, we present some estimates for the production options (see Table II-14). As pointed out above in regard to solar as a production option, there is a good deal more variation among the studies in projecting the production estimates. In the near term, synthetic fuels are the most variable of the production options -- 900 percent difference between the low and high estimates produced by the studies. In the longer term, geothermal shows the most variability -- 1000 percent -- with synthetics and coal being quite variable as well. Part of this variation stems from different assumptions between the studies about the baseline, business-as-usual scenario, but most of it would seem to stem from uncertainty about the response of the production options to policy and from uncertainty about the nature of policy commitments. This comes through most clearly in Table II-15, where a comparison between the rate of "improvement" in the production options is compared to that of the conservation options. Clearly, the studies are a great deal more optimistic and variable for the relative improvements on the production side. The median for expected improvement in the production options is 50 percent improvement in the near term and around 160 percent in the long term. The median expected rate of improvement for conservation in the long term is only 15 percent, with no single conservation option having an expected rate of improvement above 90 percent.

TABLE II-9

DISTRIBUTION OF TRANSPORTATION ENERGY CONSUMPTION, 1978
(in Quads)

	Amount	Percent
Automobile	10.16	50
Light Truck	2.63	13
Other Truck	2.92	14
Air	1.48	7
Rail	3.17	16
Total	20.36	100

Source:

The Easy Path, Table A-3, page 4.

TABLE II-10

PERCENT CHANGES IN ENERGY INTENSITY IN THE TRANSPORTATION SECTOR
(with various conservation strategies)

	1985*		2010**	
	(1) Moderate	(2) Aggressive	(3) Moderate	(4) Aggressive
Automobile	11	25	35	85
Light Truck	17		31	88
Other Truck	14		11	33
Air	25		10	16
Rail	--		3	9

Sources:

*The Easy Path, Table A-3, page 22.
**Transition, Table 2-3, page 108.

TABLE II-11

DISTRIBUTION OF INCREMENTAL SAVINGS IN THE TRANSPORTATION SECTOR

(Weight x Intensity/Total Weight x Intensity)

	Moderate*		Aggressive**	
		Increment (%)		Increment (%)
Automobile	.1750	72	.4250	70
Light Truck	.0403	17	.1144	19
Other Truck	.0154	6	.0462	8
Air	.0070	3	.0112	2
Rail	.0048 .2425	2	.0144 .6112	2

Sources:

*Column 2, Table I-9, multiplied by Column 3, Table I-10.
**Column 2, Table I-9, multiplied by Column 4, Table I-10.

TABLE II-12

INCREMENTAL REDUCTION IN ENERGY USE IN THE TRANSPORTATION SECTOR

(with various conservation strategies)
(in Quads)*

	1990			2000						
	Low (1)	(2)	High (3)	Low (4)	(5)	(6)	(7)	High (8)	Low (9)	High (10)
Total	6.1		11.1	6.8		16.1			13.2	21.6
Automobile	4.4	5.3	7.9	4.9	4.5	11.6	6.2	10.6	9.5	15.6
Light Truck	1.0		1.9	1.2		2.7			2.2	3.7
Other Truck	.4		.7	.4		1.0			.8	1.3
Air	.2		.3	.2		.5			.4	.6
Rail	.1		.2	.1		.3			.3	.4

Sources:

Columns 1, 3, 4, 6, 8, 9, and 10 -- based on Tables I-11 percentages applied to Energy in Transition, Table 2-3, page 108.

Columns 2 and 8 -- based on Table I-11 percentages applied to **Working America**, Table 2, page 4.

Columns 5 and 7 -- based on Table I-11 percentages applied to **Energy in America's Future**, Table 62, page 185.

*Numbers may not total due to rounding.

TABLE II-13

INCREMENTAL REDUCTION IN ENERGY USE IN THE INDUSTRIAL SECTOR

(with various conservation strategies)
(in Quads)*

	1990			2000				2010	
	Low (1)	(2)	High (3)	(4)	Low (5)	(6)	High (7)	Low (8)	High (9)
Total	5.5		7.2		6.1	12.5	14.4	15.5	22.6
Cogeneration		2.1			1.3	3.5		2	5
Housekeeping								6.2	6.2
Process					4.8	9.1		7.3	11.4

Sources:

Columns 1, 3, 4, 7, 8 and 9 -- Energy in Transition Table 25, page 122. Distribution is described in text on pages 117-119.

Column 2, Working America, in text.

Columns 5 and 6, America's Energy Future, Table 6-2, page 185.

*Numbers may not total due to rounding.

TABLE II-14

INCREMENTAL ADDITIONS TO ENERGY PRODUCTION
(with various production strategies)
(in Quads)*

	1990			2000		2010	
Renewables	Low 1.8	2.7	High** 10.7	Low 5.7***	High 10***	Low 10.7	High 24.2
Biomass	--	--	4.3	1.9	5.4	1.9	5.4
Solar	1.7	2.6	{ 6.4	3.8	4.6	8.8	18.8
Hydro	.1	.1	--	--	--	--	--
Coal (net)	1.0	6.3	4.7	4.1	37.3	4.1	33.5
(Synthetics)	.4	.8	3.6	.1	5.4	2.6	10.6
Shale	.7	2	3.2	1	2.5	1.5	3.0
Geothermal	.6	1.8	0	.7	6.9	1.7	17.5
Nuclear	3	2	0	17.5	15	25.9	26.7
Oil	4	5	0	6	8	10	12
Gas	5.8	7.7	0	8	10	9	11

Sources:

*All figures are from Energy in Transition, Table 11-13, page 672 except the following:

**Working America, Table 2, page 41.

***Working America, page 129.

TABLE II-15

PERCENTAGE IMPROVEMENT IN ENERGY PERFORMANCE POSSIBLE BY 2010

PRODUCTION: Increase in Output	Low	High
Oil	167	200
Gas	180	220
Shale	*	*
Synthetics	25	104
Coal	—	105
Geothermal	71	729
Solar	1683	4700
Nuclear	164	169
Hydro	0	0
CONSERVATION: Decrease in Energy Intensity		
Thermal Integrity		
Residential	10	10
Commercial	14	40
Government	10	30
Space Conditioning		
Air	20	30
Electric Hot Water	30	42
Gas & Oil	6	10
Refrigeration	24	37
Utility	0	14
Transportation		
Automobile	35	85
Light Truck	31	88
Other Truck	11	33
Air	10	16
Rail	3	9

Source:

Energy in Transition, Table 2-3; page 108, Table 2-4, pages 114-115; Table 11-13, page 672.

E. The Contribution of New Buildings in National Perspective

In Table II-16, we have integrated the estimates for each of the various components of the energy picture. A number of general points can be made in passing, before focusing on new buildings.

1. It is strikingly clear that conservation is an option of major national importance, especially in the short run. For the next decade, it is almost certain to be more important than the production options. The estimates for energy produced from conservation range from 19.6 quads to 31.2 quads in 1990, compared to estimates for the production options which range from only 5.2 quads to 42.6 quads. One can safely say that energy conservation is indispensable to a smooth energy transition.

2. Even in the long run, energy conservation, as an overall option, is of considerable importance. At no point is itsexpected contribution less than one-half of the expected contribution of the production options and, generally, conservation is equal to three quarters of production as a potential energy source. Thus, all the national estimates suggest a major role for conservation well into the next century.

TABLE II-16

INCREMENTAL ADDITIONS TO NATIONAL ENERGY RESOURCES
(with various conservation and production strategies)
(in Quads)

	1990		2000		2010	
	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
PRODUCTION	4.6	41.4	40.6	115.6	65.5	138.5
Biomass	.8	4.3	1.9	5.4	1.9	5.4
Solar	1.7	6.4	3.8	22.6	8.8	18.8
Hydro	0	.1	0	0	0	0
Coal (Net)	1.0	6.3	4.1	37.3	4.1	33.5
Synfuel	.4	3.6	.1	5.4	2.6	10.6
Shale	.7	3.2	1.0	2.5	1.5	3.0
Geothermal	0	1.8	.7	6.9	1.7	17.5
Nuclear	0	3.0	15.0	17.5	25.9	26.7
Oil	0	5.0	6.0	8.0	10.0	12.0
Gas	0	7.7	8.0	10.0	9.0	11.0
CONSERVATION*	19.6	31.2	22.5	54.4	46.9	73.0
Buildings	8.0	13.0	10.0	23.9	18.2	28.8
Appliance	1.2	1.9	1.7	2.7	2.7	3.6
HVAC	2.3	2.9	2.1	4.1	4.1	5.3
Retrofit	3.3	4.7	1.4	5.2	1.3	1.7
Envelopes	3.1	3.6	1.1	1.8	.9	1.2
Solar	.2	1.1	.3	3.4	.4	.5
New Buildings	1.2	3.4	4.8	11.9	10.1	18.2
Envelopes	.7	1.8	2.6	5.0	5.8	7.7
Solar	.5	1.6	2.2	6.9	4.3	10.5
Transportation	6.1	11.0	6.4	16.1	13.2	21.6
Automobile	4.4	7.9	4.5	11.6	9.5	15.6
Light Truck	1.0	1.9	1.2	2.7	2.2	3.7
Other Truck	.4	.7	.4	1.0	.8	1.3
Air Passage	.2	.3	.2	.5	.4	.6
Rail	.1	.2	.1	.3	.3	.4
Industry	5.5	7.2	6.1	14.4	15.5	22.6
Cogeneration			1.3	3.5	2	5
Housekeeping			4.8	9.1	6.2	6.2
Process				1.8	7.3	11.4

Source: Tables II-8, II-12, II-15.

*The high estimates are the sum of the highest numbers occuring in Table II-8.

3. The conservation option clearly seems to be a more certain path. In the short term, there is less than 60 percent difference between the low and high estimates of conservation energy. For the production options, the difference between estimates is 700 percent. In the long run, the production options tend to stabilize somewhat in their high and low estimates, but they still remain more variable than the conservation options.

Now let us turn from conservation-versus-production to conservation in new building envelopes. We observe that:

1. New building envelopes (combining conventional conservation methods and solar) represent a potential contribution to national energy resources roughly equal to or greater than any of the other 24 options (10 production, 6 conservation, 5 transportation and 3 industry options) with the exception of one or two of the least certain production options.

As Table II-16 shows, in the near term, combining solar and conventional forms of conservation in new buildings, the low estimate is 1.2 quads, surpassed only by the savings potential of centralized solar, retrofit of old buildings and increased automobile efficiency. For the near term high estimate, new buildings are set at

3.4 quads, just at the average of all production options (3.5 quads) with half the production options being lower. Among the conservation options, only automobiles and building retrofit surpass the savings potential of new buildings.

In the long term, conservation in new buildings becomes the most attractive of all the conservation options, with a low estimate of 10.1 quads and a high estimate of 18.2 quads. This compares quite favorably with the production options, which have an average of only 6.6 quads on the low side (only nuclear surpassing buildings) and 20.4 quads on the high side (with only 3 options, centralized solar, coal and nuclear, surpassing buildings).

2. It is particularly notable that even in the short run, new buildings hold their own as an option. As we have seen, it takes a good deal of time for housing stock to turn over; thus one would have expected new buildings to be somewhat at a disadvantage as an option in the near term. The positive short term potential for new buildings is likely a result of two factors:

a. There is a great deal of potential for conservation in new buildings; and

b. Other options take a good deal of time to come on line as well.

3. As with the other conservation options, the estimates for new buildings are more stable than the estimates for production options. Thus, this sector provides a more certain path for energy savings.

4. Even within the realm of conservation options, new buildings appear to be a good choice. In the near term, automobiles and retrofit are the only conservation options that are more attractive. However, in the middle term and thereafter, new buildings are the only conservation option that match or surpass the conservation potential of automobiles. Thus, even with respect to what has been the target of great publicity in the realm of conservation -- automobiles -- conservation in new buildings deserves more attention and support.

One can safely conclude that conservation in general and conservation in new buildings in particular can and should play a major role in America's energy future and, therefore, deserves attention and funding equal to any other energy option.

CHAPTER III

BUILDING ENERGY PERFORMANCE STANDARDS: The Need for Mandatory Regulations in The Building Sector

A. The Role of BEPS in America's Energy Future

The potential contribution of new buildings to national energy resources as formulated by these major studies can now be compared with the actual contribution which DOE's analysis projects for the BEPS program. These figures are presented in Table III-1. Nominal BEPS are the standard chosen by DOE in the NOPR; strict BEPS are an alternative which embody "tight" buildings. Neither of these necessarily assumes the use of solar in the building. Furthermore, in making any comparisons between the national estimates of the contribution of new buildings and BEPS program estimates, we should compare the BEPS estimate for 1995 with the national study estimates for 1990. The reason for allowing the five year time lag is that the national study estimates generally use 1977 or 1978 as the base year, while the BEPS program estimates start in 1980 or 1981.

As formulated by DOE, nominal BEPS for 1995 are roughly at the level of the low estimate projected by the national studies for 1990 for conventional conservation (.7 quads). Moreover, strict BEPS in 1995 are close to the high estimate for the studies for conventional conservation in 1990 (1.4 quads). While the nominal and strict estimates

TABLE III-1

THE CONTRIBUTION OF BEPS COMPARED TO NATIONAL ENERGY STUDY ESTIMATES
(in Quads)

		1990	1995	2000
Nominal BEPS*		.55	.76	.93
Strict BEPS**		1.0	1.42	1.75
National Study*** Projections for New Buildings	Total	1.2-3.4		4.8-11.9
	Conventional	.7-1.8		2.6- 5.0
	Solar	.5-1.6		2.2- 6.9

Source:

*Nominal BEPS estimates from Economic Analysis, Table 5-14, pages 5-27.

**Strict BEPS estimates are the sum of case 3, Table D-1, page D-4 and case NNS, Table D-2, page D-36, Economic Analysis.

***From Table II-16.

are close to the low and high estimates for conventional conservation, they do not come close to the estimates of the total contribution of buildings. Strict BEPS is just slightly higher than the total low estimate and nominal BEPS is only 65 percent of that low estimate. In sum, a standard set at the strict level would seem to be the bare minimum that can be achieved in energy conservation in new buildings in the near term.

It is worthwhile to reflect on why the BEPS estimates are so low in the near term.

1. First, it should be kept in mind that strict BEPS is not an aggressive policy by the definition of most of the national policy studies since it does not include life style changes and it relies only on the average of current technology -- not new technology. Thus, it would be quite consistent to consider strict BEPS a low estimate of the potential contribution of new buildings.

2. Second, the BEPS program, as formulated, makes no effort to include or require the use of solar, over and above the contribution of conventional approaches to conservation. That is, in the framework of DOE's approach to BEPS, use of solar energy is seen as a tradeoff against conventional conservation, rather than an addition to it. It would easily have been possible, within the framework of the legislative mandate, to have taken

a different approach. DOE could have required the achievement of the maximum conservation that was possible through conventional means and coupled that with the requirement that buildings also achieve the maximum conservation that was possible through the use of solar energy. This would be one way of interpreting the legislative mandate that BEPS be "designed to achieve maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy." If this approach had been taken, the expected contribution from BEPS would be at least 15 percent greater and could be as much as 30 percent greater.

Comparing the expected BEPS contribution in the longer term with the estimates of the national studies for the buildings sector, there appears to be even greater divergence. However, there are two easy explanations for this. First, the BEPS estimates are based on a particular set of innovations introduced at the outset and carried over the period of time. No updating of the standards is factored for later years. Clearly, one can expect improvements further down the line which would make more conservation possible. For gas heating, nominal BEPS involve only a 19 percent improvement in energy intensity while strict BEPS involve a 56 percent improvement. At least some of the national study estimates for later points in time embody higher expectations for improvement than these.

Second, the BEPS estimates, because they are part of a proposed federal program which must be justified in terms of cost, assume that a good deal of change will occur in the absence of a regulatory program. The contribution of BEPS is calculated over and above a basic set of improvements. Specificially, they are calculated with the estimates of roughly 39 percent improvement,without BEPS,as a base. In DOE's analysis, by the year 2000, for every BTU that nominal BEPS saves, "natural forces" are expected to save 1.6 BTU 's, while for every BTU strict BEPS would save, "natural forces" are expected to save .8 BTUs.

Thus, for the year 2000 in BEPS, the total energy savings by conventional means (BEPS plus natural forces) would not be entirely out of line with the year 2000 in the national estimates. This is brought out in Table III-2. The BEPS contribution is added to the baseline (natural forces) contribution. This number is then adjusted for the time lag, The nominal BEPS estimate comes close to the low estimate for conventional conservation in the national studies, while the strict BEPS estimate comes close to the high estimate.

These figures suggest 1) that the parameters of conventional approaches to energy conservation in buildings are well known; 2) that nominal BEPS are not adequate, at least from the point of view of the national studies; 3) that strict BEPS would ensure the minimum

TABLE III-2

THE YEAR 2000 CONTRIBUTION OF BEPS
(in Quads)

	BEPS 2000		National Study Estimates Contribution of New Buildings		
	Adjusted for Baseline (Natural Process)	Adjusted for Time Lag	Conventional	Solar	Total
Nominal (low)	2.4	3.6	2.6	2.2	4.8
Strict (high)	3.2	4.5	5.0	6.9	11.9

Source:

Calculated by CECA on the basis of Oak Ridge National Laboratory Residential Energy Model and assuming that 2 percent per year addition to housing stock will be covered by BEPS.

that most studies project; 4) that solar needs to be added to BEPS if the buildings sector is to contribute at moderate to high levels of conservation; and 5) that periodic updating of the standards is probably indispensable to ensure that the contribution of buildings will remain in the moderate to high ranges.

On these grounds, an aggressive BEPS program, one which is closer to the strict level, is called for. However, there is an additional reason why such a program is justified. The above analysis, and DOE's own evaluation of the BEPS contribution, is predicated on the assumption that a very substantial amount of conservation will take place in the absence of mandatory standards. However, as the next section suggests, we believe that DOE may be overly optimistic about how much "natural forces" will contribute to energy conservation in the buildings sector. From this point of view BEPS actually would contribute more than DOE has estimated and BEPS becomes an essential guarantee that conservation will take place.

B. The Necessity of Regulation of Energy Use in New Buildings

Having established the large contribution that new buildings can make to America's energy future, the next step is to examine how to ensure that the contribution actually occurs. The Consumer Energy Council of America strongly supports the implementation of a regulatory program as the only way to achieve the full potential of new buildings to conserve energy. We believe that it is the force of regulation rather than market forces that will achieve the goal, because the market for new buildings suffers from a number of structural imperfections.

CECA does not stand alone in taking this position. Even the Ford Foundation, which has taken an extremely pro-market position generally, makes an exception for the buildings sector.[1] First, the report lays out the general justification for regulation:

> Where exact information is difficult or expensive to get for a consumer, regulations can help substitute for the perfect knowledge that a market economy presupposes. (Even though the regulator's knowledge may be no more perfect than the consumer's, at least in the aggregate, government is generally in a position to assemble somewhat better data than a consumer working alone). Where energy considerations are a small part of any one individual's buying decision but a large part nationally, regulations may serve to limit the range of choices so that consumers are led to act in a way that will benefit them all. Regulations can serve where structural characteristics impede or frustrate operations of market forces.[2]

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[1] While we agree with the Ford Foundation conclusion that the building sector, because of market imperfections, requires regulation, we do not agree that other sectors do not need regulation. We believe that the Foundation has underestimated the imperfection of markets in these other sectors.

[2] Energy: The Next 20 Years, p. 138.

Then Ford argues that the buildings sector exhibits precisely those characteristics which justify regulation.

> This failure to use the regulatory process for correcting deficiencies in the residential energy market is unfortunate because the housing market is almost a classic case in which intelligently conceived regulation has a place. Homebuyers do not generally think in terms of life cycle costing. Energy-conserving features are hard to evaluate, even in an older house, and almost impossible to judge in a new house where there is no history of utility bills to rely upon. Labeling would help consumers judge relative efficiencies of homes, but studies suggest that such labeling would be difficult to do accurately from a technical standpoint. Therefore, a standard that was relatively easy to administer, that took into account the benefits of energy conservation to both the consumer and to the nation, and that permitted exceptions in cases where direct regulation was inappropriate would have a great deal to commend it. It remains to be seen whether the BEPS will measure up to these tests. 3/

A review of all of the studies cited above quickly reveals the specific reasons why regulation is necessary in this sector. The best approach is to frame the analysis in terms of the obstacles to conservation in the buildings sector, as has been done in Table III-3. What we find is a preponderance of obstacles stemming from the market structure of the buildings sector.

3/ Energy: The Next 20 Years, pp. 136-137.

TABLE III-3

MARKET STRUCTURAL OBSTACLES TO CONSERVATION IN NEW BUILDINGS

A. Demand Related Problems

1. Smallness of fuel to total cost ratio
2. Difficulty of life cycle cost approach
    a. Calcuation of stream of benefits
    b. Uncertainty of fuel prices
3. Difficulty of information gathering
    a. Complexity of information
    b. Discontinuity of decisions
    c. Ambiguity of feedback

B. Supply Related Problems

1. Builder non-operation of building
2. Inverted communication mechanism
3. Profitability of intertia
    a. Cost of change
4. Sluggishness of response
    a. Decentralized industry
    b. Craft based, nonstandardized design and production
    c. Financing practices

Source:

CECA

The failure of a market to solve a problem is essentially a failure in one or two aspects of the market's structure. The incentives may not push in the direction of a solution and/or, even though the incentives are there, the market may not be able to provide the solution. The buildings market suffers from both deficiencies and, therefore, it has failed to produce the optimum level of conservation in new buildings.

The failure of incentives can be broken down into two aspects, the demand side and the supply side.

1. The Demand Side

On the side of demand, there are a number of factors which have blocked the buildings market from achieving the optimum in energy conservation.

a. Historically, energy consumption has not been a major factor in the decision to purchase a building. Fuel costs in relation to capital costs were small so that optimizing energy conservation was not a consideration. With the recent crushing increases in energy prices, this has begun to change, but, in the absence of regulation, a prolonged period of adjustment can be expected before buying habits change dramatically.

b. Even if energy becomes an important element in decisionmaking, the consumer would have difficulty factoring the life cycle costs of new buildings. A life cycle cost point of view requires the calculation of a long term stream of benefits. Homebuyers have difficulty making this calculation, especially when the stream of benefits rests on highly uncertain projections about fuel prices. The evidence suggests that consumers have begun to take a longer term economic view of the expected energy use of new homes, but even with a period of adjustment, life cycle cost approaches requiring complicated calculation will probably always present a challenge to the consumer of residential buildings.

c. The gathering and interpretation of data necessary to make an optimum decision also remains a problem for all consumers. The complexity of the necessary data is a major obstacle. The precise combination of conservation options which are optimum in a particular place at a particular time involves the balancing of a host of factors, many of which are highly technical in nature.

d. The consumer does not make this decision on a continuing basis so that it is difficult to build up the necessary relevant information and expertise to execute optimum decisions. Homes and buildings are purchased on a discontinuous basis -- for homes, an average of once every five years or so. If there is little opportunity to learn from prior choices, the feedback is slow.

e. Moreover, the feedback may not be very clear. If one purchases an energy inefficient building, its expression will be in terms of high monthly energy bills, but whether the precise cause is the envelope, the HVAC system, the appliances or the operation of the building is not clear.

Thus, we are assuming that consumers are ready and willing to make the optimum energy choice in buildings, but that the structure of the decision process makes it extremely difficult to reach that choice. It is precisely in this case that, as the Ford study noted, "regulations may serve to limit the range of choices so that consumers are led to act in a way that will benefit" [4] each one individually and the nation as a whole.

2. The Supply Side

It is entirely possible that suppliers can move the market toward a solution if it is in their economic interest to do so. However, the supply side of the buildings market has certain structural problems which inhibit this.

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[4] Energy: The Next 20 Years, p. 132.

a. The builder purchases the equipment and constructs the building but does not have to operate it. The builder's choice may be dictated by considerations other than optimum energy efficiency -- considerations such as immediate profit, financing charges, the desire to keep sales price (as opposed to total cost over the life of the building) low, etc.

b. While it is clear that builders must respond to consumer demand preferences, it is also clear that the mechanism for transmitting these preferences is inverted and sluggish. Most residential consumers and many commercial consumers do not commission new buildings; they purchase those that have already been built. Since most builders build a few buildings, they are exposed to only a few transactions per year and, generally, do not engage in a lot of market research. It may be that, by presenting certain types of buildings on the market, builders have as great an impact on what is available as do consumer preferences.

c. Insofar as we can hypothesize that builders may have a significant influence on market performance by the products that they place on the market, then we must recognize that they have a considerable interest in not changing those products. It costs less to continue old patterns -- to use on-shelf designs and in-place construction practice -- than to change.

d. Even if market incentives were pointing strongly in the proper direction to solve the problem, certain industries do not respond well to incentives. The building industry is decentralized so that innovation and change do not diffuse rapidly. It is a craft-based industry with non-standardized design and non-standardized production so that an effective across-the-board response is difficult. One may find rapid adaptation in certain areas, but other areas where little change occurs. Moreover, the financing arrangements which typify the market and which are of particular importance in decision-making are also slow to change. They tend to overemphasize capital cost and disregard operating costs, which works to the detriment of conservation.

No doubt an adjustment process will take place on the supply side and between the forces operating on suppliers and those operating on consumers. However, this adjustment may take considerable time and, in the interim, a large stock of energy inefficient buildings will accumulate. Thus, on the supply side, too, regulation can serve to point the decisions of the suppliers in the right direction by blocking the easy path they are most likely to follow -- the path of continuing to build energy inefficient buildings.

In sum, in the absence of regulation the very imperfect market for new buildings will grope toward better energy decisions but that will take a great deal of time and waste a great deal of money and energy in the process. Moreover, in the long run, though energy decisions will improve due to market forces, they will remain far from optimum because of imperfections in the market.

C. A Formal Representation of Market Imperfections in the Buildings Sector

DOE's Economic Analysis technical support document includes a brief, formal discussion of the reasons why the market will not solve the problem, but it is carried out in a very abstract manner and without much enthusiasm. Since this is the theoretical and technical justification for the program, as opposed to the cost/benefit justification, we believe it is worth DOE's restating the argument with greater specificity and conviction.

We assume that a true life cycle cost optimum exists in the consideration of energy efficient buildings. This is the point at which the cost of consuming the next unit of energy is exactly equal to the expected benefit of not consuming it. This point occurs at the level of energy use indicated by E_0 in Figure III-1(a). If the true life cycle cost optimum does exist, why then might the market not be operating at this point? Since the market decisions are made by both suppliers and consumers, we ask how each might misunderstand the costs and benefits or how market structures might distort costs and benefits.

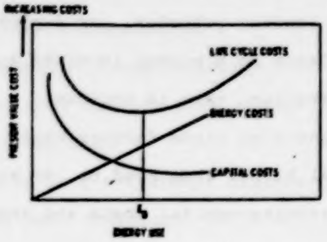
The difficulty of life cycle costing, especially the uncertainty of future fuel prices, can lead the consumer to underestimate energy costs in the future. The ambiguity of feedback and a general lack of information may also lead to the underestimation of the cost of energy associated with the shell of the building. The result is to justify less conservation and, hence, more energy use. As in Figure III-1(b), energy use moves from E_0 to E_1, because costs of energy are perceived as too low.

Capital costs related to energy conservation can be perceived as too high in a number of ways. The consumer's sensitivity to first cost tends to "overvalue" capital outlay. Also, uncertainty about new technologies may lead one to overestimate maintenance and operating costs.

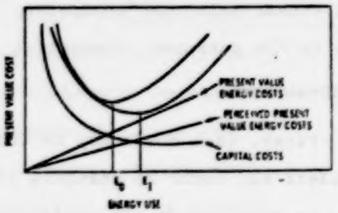
FIGURE III - 1

MARKET OPTIMA AND CAUSES OF SUBOPTIMAL OUTCOMES

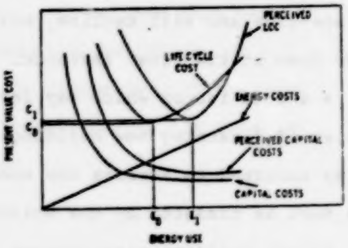
a) The optimal energy use based on true energy costs and capital costs.



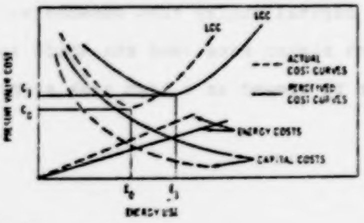
b) The impact of under-estimating energy costs.



c) The impact of over-estimating capital costs.



d) The combined impact of underestimating energy costs and overestimating capital costs.



Source:

Economic Analysis, pp. 3-8 thru 3-11.

Financial institutions, failing to respond to the shifting weight of capital and operating costs, may fail to adjust their lending policies. As depicted in Figure III-1(c), this leads to a higher level of energy use, i.e., less conservation, than is optimum.

One also finds factors which make the real cost of capital higher than need be, or at least lead suppliers to overestimate capital costs and thereby resist incorporating more conservation into buildings. Having taken the position that conservation is "expensive," the builder then communicates that to the consumer, distorting the consumer's perception of these costs.

First, real costs may be increased by the costs that builders may incur in changing into an energy conservation mode in both design and production. These learning costs are one-time and will decline, but builders hesitate to incur them in the first instance.

A second factor which may increase real costs is the problem of financing new buildings. The additional capital outlay incurred to improve the energy performance of buildings must be financed by the builder.

Third, builders also operate with a different conception of capital outlay than consumers. They discount capital at a much higher rate (and the shift into an energy conserving mode can be viewed as a high risk step raising the builder's discour rate even further). Whether these costs are real (albeit temporary) or only perceived, they raise the capital costs above what they actually are. Builders communicate the misperception of costs to consumers in the buildings they build and in the information they disseminate. Thus, they pull the market away from the optimum.

Each of the factors cited above is a systematic feature of the market structure for buildings and, therefore, is not likely just to disappear with time. Putting the demand and supply effects together, as in Figure III-1(d), the behavior of the market can be quite far off the optimum. The role of regulation would be to counteract the structural tendencies of the market to overestimate the costs and underestimate the benefits of conservation. As the Ford Foundation argued, "the role of regulation can be to move the market toward its optimum." 5/ We believe that the deficiencies in the market structure for buildings are real and not likely to disappear by themselves. Regulation can correct those deficiencies, thereby saving the consumer money and saving the nation energy.

5/ Energy: The Next 20 Years, p. 138.

D. Conclusion

In Part 1, we have seen that conservation in buildings can play an important role in national energy policy. The level of contribution implicit in the major recent national energy studies is quite close to the levels explicitly calculated in the BEPS analyses. It is clear, on the basis of both the quantitative and qualitative analysis, that regulation through stricter standards than proposed by DOE is necessary to bring about levels of energy conservation that will make a significant contribution to a brighter energy future.

Part 2 of this report is intended to provide evidence to support improving standards. While the remaining chapters will frequently be critical of DOE's analytical work, CECA's analysis lays the groundwork for arriving at a reasonably strict, practicable and fair set of standards. Thus, CECA's analysis will hopefully serve as a constructive contribution to DOE's standard-setting process and to the development of final BEPS.

Part Two:

TECHNOLOGICAL AND ECONOMIC ISSUES IN ENERGY BUDGET SETTING

CHAPTER IV

SETTING RESIDENTIAL ENERGY BUDGETS

A. DOE's Underestimation of the Potential for and Benefits of Conservation

1. The General Approach

In Part 1, we have demonstrated that 1) new buildings can make a major contribution to national energy resources; 2) regulation is necessary in order to ensure that they do so; 3) DOE has underestimated the potential contribution that BEPS can make; and 4) DOE has set the standards at a level that fails to achieve even the minimum that can be accomplished. In Part 2, we examine some of the methodological reasons why DOE has failed to propose a sufficiently strict standard.

DOE's underestimation of the potential contribution of BEPS stems from two sources. First, at the micro level, DOE has taken such a cautious approach in terms of its assumptions, its data and its methodology that it has set extremely lenient budgets. The budgets are so lenient that the contribution of the program is rendered miniscule. Even within the framework of DOE's own analysis, this leniency is not justified. Second, from a macro point of view, DOE has taken such a rosy view of the future without BEPS (the ORNL model)1/ and has set such constraints on the evaluation criteria that BEPS seem small in significance. For the buildings sector, neither the rosy view of the future nor the evaluation criteria are truly justified by the evidence.

Part 2 examines the micro level flaws in DOE's analysis. The purpose is to review the existing analysis with three objectives in mind:

a. To show the points where DOE's analysis, even as it stands, suggests that stricter standards could easily have been chosen. These are the points where DOE has taken caution beyond the point where it was justified.

b. To highlight the points where the rapidly changing energy situation has rendered the DOE analysis obsolete. The deterioration of the energy situation (expressed primarily in skyrocketing fuel prices) demands greater conservation. Decisions that looked reasonably cautious a year or two ago look foolishly timid in the light of current circumstances.

c. To underline peculiarities in DOE's methodology which have rendered its analysis ineffective. By stressing these peculiarities, we hope to convince DOE to change its methodology and, thereby, make future analysis more meaningful.

1/ The Oak Ridge National Laboratory Residential Energy Model is described in the Economic Analysis, Appendix G and H.

2. Specific Aspects of the Analysis

In order to accomplish these goals, we examine a series of conceptual and methodological points that have a major impact on the results of the analysis. These are the points at which DOE has seriously underestimated the potential for conservation in both residential and commercial buildings. In Part 2, seven general issues will be examined:

a. Certain restrictions were placed on the levels of insulation that were considered in the life cycle cost analysis of residential buildings. This prevented these analyses from arriving at true optimum levels of conservation. Energy budgets could have been lowered roughly 10 percent if these options had been considered.

b. There were a number of conservation options excluded from the analysis because they are owner-operated. This prevented DOE from including a number of mechanical devices which are both highly cost beneficial to the consumer and could have reduced the energy budgets by roughly 10 percent.

c. The analysis of the potential contribution of solar conservation was extremely limited and carried out with a general approach and under a set of assumptions that gave solar energy no real opportunity to play a part in the final standards. The potential contribution of passive solar systems runs from 10 to 30 percent. The potential contribution of active solar systems can be as much as 85 percent.

d. The commercial budgets were set through an extremely dubious methodology and without a full economic analysis. The result is that the energy budgets do not even begin to encourage the levels of conservation that are easily achievable. The budgets probably could have been reduced as much as 50 percent.

e. The values chosen for the variables (especially fuel price projections) entered into the LCC analysis of residential buildings (conventional and solar conservation) and the net present value (NPV) analysis of commercial buildings are unrealistically low. The result is that DOE has underestimated the value of conservation by a factor of two or three.

f. The weighting factors approach taken by DOE to affect the choice of fuels confuses the analysis. In fact, it focuses the entire program around the wrong consideration -- relative fuel prices -- and thereby fails to achieve the optimum in energy conservation.

g. The assumptions underlying the methodology used to evaluate the national impact of the BEPS program contradict the assumptions used to design the program. The net result is that the impact of the program appears extremely small. If the assumptions underlying the BEPS analysis are correct, then the national impact analysis must be done over with the proper assumptions, so that the true impact of BEPS can be assessed. If the assumptions underlying the national impact methodology are correct, then the BEPS program needs to be redesigned so that it fits reality better.

Taken together, these flaws in the analysis have led DOE to underestimate the potential for energy conservation in new buildings by a wide margin. The potential benefits to the consumer and the nation are enormous. In critically reviewing each of these areas, we hope to convince DOE to issue stricter standards and thereby ensure that the benefits will be realized.

B. Restrictions on the LCC Analysis of Residential Buildings

1. The Choice of Levels of Insulation

For a variety of rather poorly documented reasons, DOE has chosen to restrict the maximum amount of conventional insulation considered in the LCC analysis -- R_{38}

in ceilings, R_{27} in walls, and 3 panes of glass. This stems from the decision that:

> the only energy conservation measures considered were those currently in common practice in the United States. These included increased levels of insulation in the walls, ceilings and floors and the consideration of double and triple glazing in addition to single glazing. 2/

For each maximum level of insulation established, a number of technical considerations are raised, e.g., the height of the attic, the thickness of the walls, window casings, as well as institutional considerations, e.g., availability of studs, insulation, or glazing. No systematic analysis of these technical and institutional obstacles was carried out.

Moreover, we are not satisfied with DOE's assumption that the limit on "maximum practicable improvements" is set by "common practice." Our critique of this approach to defining maximum practicable improvement is developed at length in Chapter IX of this document. For present purposes, we focus on the impact that these restrictions have on the

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2/ NOPR, p. 2-18.

economic analysis.

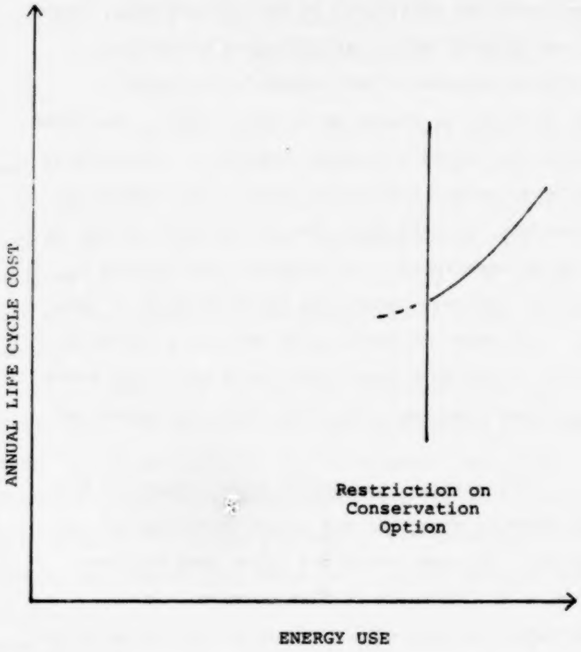
2. The Impact of Restrictions on LCC Minima

As a result of the restriction on the amount of insulation which was considered in the LCC analysis, there are a number of cases in which the LCC curve either does not reach its true minimum or the minimum is in doubt. Conceptually, this can be viewed as in Figure IV-1. The life cycle cost curve is taking its normal descent -- lower energy use yielding lower annual life cycle costs -- but before it reaches its minimum, it runs into the restrictions placed on the options to be considered. For example, one reaches R_{38} insulation in the ceilings before the curve appears to have bottomed out. One would be inclined to move to a higher R value to see if it yields a lower life cycle cost, but since DOE ruled out these R values, one never finds out where the bottom is.

The problem is rendered more complex in the BEPS analysis because more than one conservation option was being considered. In cases where the curve does not have a sharp bottom, i.e., where it is flat bottomed, it is difficult to judge the cost effectiveness of one conservation option on the basis of the behavior of another. For example, if six inches of wall insulation (which may still be considered because the maximum level allowed has not been reached) shows

FIGURE IV-1

THE EFFECT OF RESTRICTIONS ON CONSERVATION OPTIONS ON THE LIFE CYCLE COST ANALYSIS



Source:

CECA

a slight increase in life cycle cost, this does not automatically mean six inches of ceiling insulation would cause an increase in LCC. The cost and thermodynamic differences between walls and ceilings render this comparison problematic when the curve is flat bottomed. This difficulty is compounded by the fact that the BEPS analyses were done with six inch increments in insulation, which fail to produce a smooth curve. That is, near the optimum, an inch or two of insulation might be cost justified, whereas six inches might not be.

A brief review of the LCC curves provided in the Economic Analysis and the Energy Budget Level Selection support documents leads to a clear pattern of missed LCC minima. These are depicted in Table IV-1. Overall, very few of the houses heated by electricity reach their LCC minima and roughly one-half of the gas heated houses fail to reach the LCC minima (or their minima are in doubt).

Fewer of the strict BEPS houses are at their minima. One interpretation of the fact that the strict cases are less likely to be at their LCC minima would focus on the approach DOE has taken in arriving at the strict energy budgets. These lower energy budget levels are achieved by tightening the building, i.e., reducing the number of air changes per hour. Apparently, when one reduces the heat loss through uninsulated spaces (which is the logic underlying the tightening of the building) insulated surface can become more

TABLE IV - 1

LCC MINIMA MISSED DUE TO CONSTRAINTS ON INSULATION OPTIONS

	Electric Heated		Gas Heated	
	Questionable Minima	Missed Minima	Questionable Minima	Missed Minima
Nominal BEPS	Atlanta	Chicago Fresno Fort Worth Houston Minneapolis Phoenix Portland Washington,D.C.	Chicago Fresno Houston Minneapolis Fort Worth Phoenix	
Strict BEPS		Chicago Fresno Fort Worth Houston Minneapolis Phoenix Portland Washington,D.C.	Chicago	Fresno Fort Worth Minneapolis Phoenix Portland Washington,D.C.

Source:

Energy Budget Level Selection, pp. A-1 thru A-20.

important. That is, more heat is forced against the insulated surface and, therefore, additional insulation may become cost justified. 3/

3. The Impact of Restrictions on Benefit/Cost Ratios

The failure to reach LCC minima in some cases -- more specifically, the fact that the analysis stops at different points on the LCC curve in different climates and for different fuels -- has a direct and striking impact on the economics of the prototype houses. Because conservation options tend to have declining marginal returns around the LCC minima, i.e., each additional dollar of conservation buys less benefits than the previous dollar, those houses which are closer to their true minima tend to have a lower benefit/cost ratio. Since the restrictions on the level of insulation tend to be reached in colder climates and for electrically heated houses, i.e., they are farther from their optima, these tend to have higher benefit/cost ratios.

Table IV-2 shows the benefit/cost ratio by city, with the cities ranked according to their number of heating degree days. The difference between gas and electrically heated houses is clear. It is also clear that warmer climates have lower benefit/cost ratios. The benefit/cost ratios

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3/ There is one case where this actually happens in the LCC analysis (see Economic Analysis, Table 4-9).

TABLE IV-2

CONSERVATION DICTATED BY PARTIAL LIFE CYCLE COST ANALYSIS

		Conservation Options to Meet BEPS								Boundary Energy Budget (MBtu/sq.ft./yr.)		Benefit/Cost Ratio	
		Gas Heated				Electric Heated							
City	Heating Degree Days	C*	W*	F*	G*	C	W	F	G	Gas	Electric	Gas	Electric
Minneapolis	6,889	38	25	—	3	38	25	—	3	54.5	38.9	2.45	5.19
Chicago	3,721	38	19	—	3	38	25		3	35.0	23.5	2.19	3.95
Portland	2,304	38	19	19	3	38	25	19	3	25.9	17.2	1.81	3.41
Wash., D.C.	1,764	38	19	—	3	38	25	—	3	22.4	15.8	1.72	2.85
Atlanta	961	38	19	11	2	38	19	19	3	18.3	11.6	2.13	3.35
Ft. Worth	784	38	19	—	3	38	19	—	3	15.2	12.6	1.82	3.18
Fresno	729	38	19	—	2	38	19	—	3	16.1	11.4	2.12	3.22
Burbank	324	19	11	—	2	30	19	—	2	7.2	4.4	1.13	1.95
Phoenix	256	38	19	—	3	38	19	—	3	12.0	11.3	1.52	2.15
Houston	196	30	11	—	2	38	19	—	3	15.1	9.9	2.06	2.31

Source:

DOE's Economic Analysis, Tables 4-3, 4-5, A-11 and A-12.

*C = ceiling
W = wall
F = floor
G = glazing

decrease very quickly as heating degree days decrease. In fact, this is a rather strong relationship. The correlation coefficient between degree days and benefit/cost ratios is .62 for gas heated houses and .91 for houses heated by electricity. 4/

C. The Impact of Restrictions on the Sensitivity Analysis

The restrictions placed on the LCC analysis also play havoc with the sensitivity analysis that DOE has conducted. As a result of the restrictions placed on the amount of insulation considered, the sensitivity analyses are, for all intents and purposes, rendered meaningless. Or, to put it in other terms, the results of the sensitivity analysis become a direct function of the constraints placed on the general LCC analysis. Let us take, one at a time, the basic conclusions which the sensitivity analyses reach.

1. Cold Climates

"In climates as cold as Washington, D.C., or colder, the nominal case is relatively insensitive to the range of economic parameters considered." 5/

4/ These figures are the Pearson Product Moment Correlation Coefficient, which is a standard measure of association.

5/ Economic Analysis, p. 4-29.

This is true largely because the nominal case houses are already at the maximum amounts of insulation which the LCC analysis permitted by assumption. Table IV-3 brings out this point. In Table IV-3, we have totalled the number of cases in which a change in insulation could have taken place and would be expected to take place. In other words, where fuel costs are increased or capital costs decreased and the insulation feature is not at its maximum, this is a case where an increase is expected and possible. Conversely, a case where fuel costs decrease or capital costs increase and insulation is not at its minimum would be a case where a decrease is expected and possible. These possible changes are compared to the number of cases in which changes actually did take place when the analysis was run.

For cold climates, it can be seen that only for wall insulation was it possible for insulation to increase. Here we observe that in one third of the possible increase cases, the analysis shows an increase. DOE's restrictions did not permit ceiling insulation or glazings -- which tend to be the most important heat loss surfaces of a building -- to increase. If we examine possible decreases in insulation, we find a strikingly different pattern.

For ceilings, there could have been a decrease in 8 cases -- none occurred. For walls, there could have been a decrease in 8 cases -- only one (12%) occurred. For glazings, there could have been a decrease in 8 cases -- only 3 (38%) occurred. If we were to state properly a conclusion from this analysis, we would say that "in climates as

TABLE IV - 3

THE USE AND ABUSE OF SENSITIVITY ANALYSIS

	CHANGES IN CONSERVATION OPTIONS								
	Ceilings			Walls			Glazings		
Washington, D.C. or Colder (Gas)	Possible	Actual	Ratio of Actual to Possible (as a %)	Possible	Actual	Ratio of Actual to Possible (as a %)	Possible	Actual	Ratio of Actual to Possible (as a %)
Increases in Insulation *	0	0	NA	0	8	NA	6	2	33
Decreases in Insulation **	8	0	0	8	3	38	8	1	12
Atlanta or Warmer (Gas)									
Increases	4	4	100	4	3	75	6	1	17
Decreases	12	4	33	12	6	50	12	3	25
Washington, D.C., or Colder (Electric)									
Increases									
Resistance	0			0			0		
Heat Pump	0			2			0		
Atlanta or Warmer (Electric)									
Increases									
Resistance	1			6			1		
Heat Pump	1			6			1		

*A possible increase is defined as a case where fuel prices are higher or capital costs lower and the insulation feature is not already at the maximum allowed.

**A possible decrease is defined as a case where fuel prices are lower, or capital costs higher and the insulation feature is not already at the minimum.

Source: Economic Analysis, Tables 4-5, 4-8, 4-22 and 4-26.

cold as Washington, D.C. or colder, the nominal case is relatively insensitive to decreases in conservation measures on the basis of the economic parameters considered, while a test of the sensitivity of the nominal case to increases in conservation has not been carried out."

2. Warm Climates

"In climates warmer than Atlanta, the nominal case is sensitive to variation in the economic parameters; however, the energy budgets do not generally vary by more than ± 10% from the nominal case in any of the sensitivity cases analyzed." 6/

Applying the same approach to warmer climates, we would once again modify the conclusion dramatically. In all cases where an increase in ceiling insulation was possible, this increase occurred. In 3 out of 4 cases where an increase in glazing was possible, it occurred. On the other hand, wall insulation (the least important aspect of the building from the point of view of heat loss) showed less of a tendency to increase (17% of the cases). Decreases in insulation were much less likely to occur in the sensitivity analysis. Only 33% of the possible ceiling decreases, 25% of the possible wall

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6/ Economic Analysis, pp. 4-29.

decreases and 50% of the possible glazing decreases occurred. Once again, we would conclude that the nominal BEPS case is sensitive to increases in insulation and relatively insensitive to decreases in insulation.

3. Electric Heat

"The results of the analysis show the electricity budgets to be less sensitive to changes in economic assumptions than the energy budgets for gas heating." 7/ This conclusion is obvious, for, as pointed out above, many of the LCC analyses for electric houses ran into the restrictions on levels of insulation before they reached the LCC minimum. In fact, there was virtually no test of potential increases in insulation.

D. Conclusions

In summary, we would conclude the following:

1. The overall impact of the restrictions on insulation considered in the LCC analysis leads to a serious misrepresentation of the levels of conservation that could have been achieved. There is simply no basis for claiming that the LCC analysis optimized conservation. The sensitivity analyses suggest quite the opposite.

7/ Economic Analysis, pp. 4-29.

2. For those changes in economic parameters that would be conducive to a decrease in conservation (lower fuel prices and higher capital costs), there is little or no tendency for such decreases to actually occur when the analysis is run.

3. For those changes in economic parameters that would be conducive to an increase in conservation (higher fuel prices and lower capital costs), there is a clearly evident tendency for such increases actually to occur when the analysis is run.

4. There is a very large number of cases where, due to the constraints place on the conservation option, there has not been a true test of possible increases in conservation.

E. Recommendations for LCC Analysis

1. The Use of Life Cycle Cost Analysis

There are three very basic areas in the LCC analysis which should be modified.

The decision to perform life cycle cost analysis embodies the noble principle of assuring that consumers get an economic return on their investment. The restrictions placed on the LCC analysis lead to the ignoble result of failing to assure the consumer the maximum possible return.

While LCC analysis should be only one criterion contributing to the setting of energy budgets, in order for it to make a real contribution to the decision, it should be done without arbitrary restrictions. If there are technical or institutional reasons why the optimum cannot be reached, they should be noted after the optimum has been identified. It is only in this way that the negative economic effects of not going to the optimum can be known and weighed against the technical and institutional obstacles to getting there. If the economic benefits of achieving the true optima are clear enough and large enough, we suspect that the technical and institutional obstacles would disappear.

CECA believes that a good set of economic numbers (such as those discussed in Chapter VII and Appendix I) and proper economic analysis show such large benefits that the minor technical and institutional problems cited by DOE as obstacles pale in comparison.

2. Equity

In addition to misrepresenting the levels of conservation that are cost-justified, DOE's approach to LCC analysis raises a second problem. This problem stems from the differences in benefit/cost ratios. Presumably, one of the objectives of the LCC analysis is to ensure that the consumer is not damaged by the imposition of a federal standard. Since all of the benefit/cost ratios are greater than 1, that has been accomplished. However, by restricting the range of choices of conservation options, huge inequities have been created between climate zones. Consumers in Burbank and Phoenix have a legitimate complaint that they are being disadvantaged by the standards.

At least one possible way to have approached the setting of the standards would have been to equalize benefit/cost ratios across the country. This should have been accomplished by letting the colder climates move to or at least closer to their LCC minima.

3. Achieving Reasonable Results

Finally, the DOE approach has created anomalies in the types of buildings that will be constructed. As a result of the constraints placed on the LCC analysis, one could end up constructing similar buildings in very different climates. Thus, the standards could be met by exactly the same gas heated building (R_{38} ceilings, R_{19} walls, 3 glazings) in Chicago, Portland, Washington, D.C., Phoenix and Fort Worth. It doesn't take an engineer to be struck by this absurdity. Intuitively, we know that Chicago is a lot colder than Phoenix and we expect an efficient building in Chicago to look different than an efficient building in Phoenix (in fact Chicago has four times the number of heating degree days and one quarter the number of cooling degree days as Phoenix). The LCC analysis must reflect reality better if it is to be meaningful. This can be accomplished by lifting the restrictions placed on it.

This discussion of DOE's LCC analyses should be kept in the context of what we know about the actual direction of change of the economic parameters which, as will be made clear in Chapter VII, has moved overwhelmingly in favor of conservation. The lid has, literally, been blown off economic constraints to conservation. The LCC and sensitivity analyses show, when viewed in a logical fashion, that even with the old economic numbers conservation was straining to break through the arbitrary non-economic constraints placed on it by DOE's assumptions. In light of what we know about the real world of fuel prices, there can be no justification for continuing to restrict the range of conservation options incorporated into BEPS. Simply put, nominal BEPS, as a possible final standard, should be a dead issue. It is an interesting starting point for 1976 or 1978, but wholely inadequate for 1980 and thereafter.

F. Behavioral Assumptions in the Residential Energy Budget Setting

1. The Exclusion of Owner-Operated Devices from Consideration as Conservation Options

The second set of restrictions that DOE placed on the LCC analysis embodied basic assumptions about behavior patterns. Of paramount importance is the decision to preclude from consideration any owner-operated mechanical devices. In the logic of DOE's approach to the standards, the fear is that owner-operated devices will be traded off against basic insulation in order to meet the standard, but that the devices will not be used and will result in the failure to achieve energy savings.

CECA disagrees with the decision to preclude mechanical devices for a number of reasons:

a. Other DOE programs -- such as the Residential Conservation Service -- are recommending such devices.

b. They are clearly cost-justified.

c. We disagree with the fundamental reasoning underlying the behavioral assumption.

d. DOE, itself, seems uncertain about its own reasoning.

e. As a consequence of our different opinion of the assumption, we do not believe that the trade-off problem would have much adverse impact on energy use.

f. We believe that the program can be easily structured to prevent any adverse effects of trading-off mechanical devices against other conservation measures.

The last four points are of particular concern to us, since they involve fundamental aspects of the program and they are likely to play an important role in future research.

2. The Role of Owner-Operated Devices in the BEPS Analysis

After precluding mechanical devices as part of the standards, which prevents DOE from evaluating them as conservation options, these devices return as sensitivity cases. The somewhat perverted logic of this approach seems to be as follows: "If the consumer builds a BEPS house, what would the impact on the economic return to the conservation investment be if the consumer also included some mechanical devices" (although DOE has no basis for hypothesizing that the consumer would choose to do so)?

The results show that, in a number of cases, the inclusion of mechanical devices changes the configuration of the house, i.e., it undermines the cost-effectiveness of one or another of the base-case conservation measures. This simply means that the mechanical device probably has a higher economic return than the conservation option that it displaces. In other words, if no constraints had been placed on the choice of options, mechanical devices would have been chosen before some of the options considered by DOE.

The issue of behavioral assumptions needs to be confronted squarely because it is confounding a proper analysis. DOE is willing to assume that people will open their windows at 78° . It is unwilling to assume that they will close insulated shutters or will manage their thermostats properly. There may be degrees of behavioral difference between these acts, but they are hardly sufficient to justify the elimination of a whole range of clearly cost-effective conservation options.

DOE's inconsistency runs deeper than the fine distinctions it has made between opening windows and closing shutters. The macro economic model (ORNL), which DOE uses to evaluate the long run impact of BEPS, actually assumes that the consumer does behave rationally in managing energy conservation.

> Households respond to changes in fuel prices in three different ways. In the short run, they change the way in which they operate existing stocks of equipment and structures, e.g., lower winter temperature settings. In the long run, they also change their capital stocks by switching from one fuel to another, by improving the efficiency of their capital stocks, e.g., purchasing a water heater with more insulation on the jacket, or both. 8/

3. CECA's Recommendations

Leaving aside for the moment the remarkable inconsistency of designing a program according to one set of assumptions and evaluating it according to another set, we believe that mechanical devices ought to be included in the BEPS program in a carefully controlled way. As part of our recommendation that BEPS be set at a lower level of energy use, we propose that a package of mechanical device conservation options, coupled with a well insulated house, be allowed as a path to meet a stricter standard. That is, we do not see mechanical options being traded off against basic insulation (as DOE seems to fear), rather we see them being added to a well insulated house to meet a stricter standard.

8/ Economic Analysis, p. 6-8.

There is not much hard evidence available on consumer management of energy saving devices, but the evidence we have seen suggests that consumers will behave rationally with respect to energy management. A study made available to CECA by the Office of Consumer's Counsel of the State of Ohio shows a clear pattern of night setback. 9/ Whereas 47% of the respondents said they set their thermostats at 69° or higher during the day (BEPS assumes a constant 70° setting) only 34% said they set their thermostats at 69° or higher at night (see Figure IV-2). This is night setback behavior without an investment in a clock thermostat. One would expect that a consumer who invests in such a device would actually be even more inclined to use the device and set it back at night.

Our insistence that DOE assume that consumers will behave rationally by operating the conservation devices they have purchased in no way contradicts our argument that regulation is necessary in order to optimize energy conservation decisions in the new buildings sector. We argued very strongly that the consumer is a rational actor. If consumers have the proper information and the market presents them with

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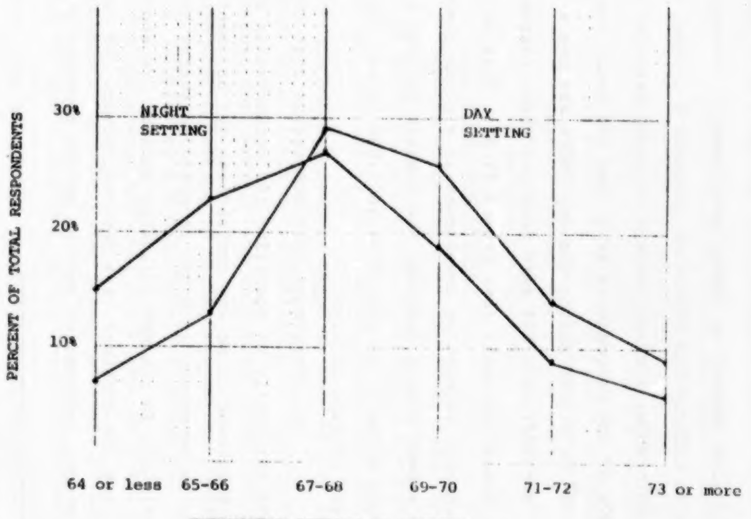
9/ See Figure IV-2.

FIGURE IV-2

DAY AND NIGHT THERMOSTAT SETTINGS



Source:

Characteristics of Ohio Residential Electric and Gas Customers (Office of the Consumers' Counsel, State of Ohio, June, 1979), pages 49-50.

a range of choices, we expect that they will make the rational economic choice. In regard to purchasing a home, the market structure, the pattern of decisionmaking and the necessary information block the consumer from reaching an optimum decision.

Thus, there are structural blockages to choosing optimum equipment to put into a building, but once the equipment is in hand, we believe that it is safe to assume the consumer will operate it rationally. The goal of BEPS is to get the right equipment into the consumer's hands and not worry about the consumer's ability to operate it properly. We think that DOE should work consistently with the assumption (which it has partially embraced) that consumers behave rationally.

CHAPTER V

POTENTIAL CONTRIBUTIONS OF SOLAR ENERGY TO RESIDENTIAL SPACE HEATING

A. DOE's Approach to Solar Energy

1. The General Attitude

The analysis of the potential contribution of solar energy to conservation conducted by DOE as part of the BEPS analysis suffers from all of the problems of the analysis of conventional conservation and many more. Indeed, there seems to have been a general and pervasive neglect of (if not hostility toward) solar energy in the BEPS analysis.

Let us begin by recalling that the BEPS program has two central foci. The program is to encourage maximum practicable 1) improvement in energy efficiency and 2) increases in the use of nondepletable sources of energy. For all intents and purposes, DOE has acted as though the second focus were non-existent. An inkling of this can be gained from the fact that the document devoted to conventional means of conservation runs 484 pages; the document devoted to solar energy -- the only nondepletable source of energy even vaguely considered by DOE -- runs only 67 pages. If one were to count the actual dollars devoted to each of these foci, we suspect that one would find that the relative neglect of solar is even greater than the number of pages indicates.

CECA believes that this seriously misinterprets --

if not outright violates -- the legislative mandate. At a minimum, it biases and distorts the program. To put it bluntly, nondepletables just never had a chance. On pages 1-2 of the Passive and Active Solar Heating Analysis, DOE states:

> Since the specific building design approach is left to the individual designer/ builder, an evaluation of the impact of the Standards on renewable energy resources would require a thorough analysis of the technical, economic, and institutional factors that influence building design and construction. While such an analysis was beyond the scope of this effort, it was possible to gain insight into several issues concerning renewable resource use by focusing on the technical/economic performance aspects.

How can it be that such an analysis was beyond the scope of the effort? Quite the contrary, Congress charged DOE with encouraging maximum increases in the use of nondepletables and if these studies were necessary, then they should have been at the center of the "scope of the effort."

As a consequence of this misinformed conception of the intent of Congress, DOE gave solar and other nondepletables short shrift.

2. Operating Conditions and Other Assumptions

To the extent that a solar analysis was done, the basic assumptions about operating conditions and behavioral patterns were biased against solar. Of special importance are thermostat settings, shading, internal loads and mechanical devices. All of these factors were chosen in such a way that nondepletable resources, especially passive solar, look much less attractive than they actually are.

In DOE's assumption, thermostats are set too high at night, thus making conventional fuels seem more important than they need be. The shading coefficients assume that during the winter, when the sun can be used for heat, 40% of the time shades or drapes would be closed, thus losing the benefits of that heat. During the summer, the shading coefficients assume that 60% of the time shades or drapes would be open, causing more energy to be used for cooling. This reduces the benefit of a solar house even further. Internal loads have been set so unrealistically high that they exhaust the potential absorptive capacity of the thermal mass of the house, thus undermining the comparative effectiveness of solar energy.

The decision to preclude all mechanical devices, especially night shutters, restricts the potential contribution of solar. The decision to assume every house has a central air conditioner forces one to assume that it has duct work, even where solar renders a small baseboard heating system adequate. In any economic analysis, the elimination of duct work would make solar very cost competitive.

Even in the direct analysis of solar, DOE took an approach which was biased against solar options. It failed to start from the logical place -- incorporating all free passive solar -- and it failed to consider the most logical possibility -- free passive solar space heating plus active solar heating of hot water. Ultimately, by its own admission, "The approach taken in this analysis results in less than the optimum amount of passive solar glazings." 1/

B. An Alternative Approach to the Analysis of Solar Energy

1. Thermal Mass and Shading Management

In order to gauge the impact that DOE's basic assumptions had on its analysis of solar energy, CECA commissioned the National Center for Appropriate Technology (NCAT) to perform a series of solar analyses with different assumptions. The full report is presented in Appendix II. Some of the most important conclusions of the NCAT analysis will be reviewed here (see Table V-1).

The base case for this analysis is a two story house in North Omaha, Nebraska. A two story house was used because DOE's unrealistically high estimates of internal load make it very difficult to conduct solar analysis

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1/ Passive and Active Solar Heating Analysis, pp. 4-5.

TABLE V - 1

THE EFFECTS OF SHADING, SOUTH FACING GLASS AND THERMAL MASS ON ENERGY LOAD

(North Omaha)

	Heating Load MMBTU/yr	Cooling Load MMBTU/yr	Total Energy MMBTU/yr
25% Glazing N,E,S,W			
Low Mass			
40% Shading Loss	54.27	4.82	59.09
5% Shading Loss	49.01	8.06	57.09
Shading Mgmt.	49.01	4.82	53.83
High Mass			
40% Shading Loss	51.57	4.11	55.68
5% Shading Loss	44.23	6.15	50.98
Shading Mgmt.	44.23	4.11	48.34
All South Glazing			
Low Mass			
40% Shading	49.27	6.04	55.31
5% Shading	45.70	1149	57.19
Shading Mgmt.	45.70	6.04	51.74
High Mass			
40% Shading	42.76	4.32	47.08
5% Shading	34.49	8.33	42.82
Shading Mgmt.	34.49	4.32	38.81

Source:

NCAT Analysis, see Appendix II, pages 9-12.

on its one story house.. The climate in North Omaha is almost identical to that of Chicago for purposes of solar analysis. 2/

With respect to the base case, we observe that the assumptions about shading and thermal mass are of considerable importance.

Reducing the shading loss from 40% to 5% reduces the heating load by roughly 10% (from 54.27 MMBTU/yr to 49.01 MMBTU/yr). At the same time, without proper management of shading, it increases the cooling load by 67% (from 4.82 MMBTU/yr to 8.06 MMBTU/yr). The net result is a reduction in total energy use of only 3.5% (from 59.09 MMBTU/yr to 57.07 MMBTU/yr). However, if we were to assume that the shading loss is properly managed, i.e., low loss in the summer (40%), a much larger reduction in total energy load is achieved, 9%. In fact, truly effective shading management would probably lead to a much lower cooling load, since shading loss of 80% or 90% in the summer is readily achievable.

Adding mass to the house in this relatively cold climate also reduces energy load. With a 40% shading loss in the high mass house, the heating load reduction is 5%, the cooling load reduction is 15% (cooling load reduction is the

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2/ See the Climate Tables, NOPR, pp. R-33 and R-36.

result of contact with the ground which has a lower temperature than the air during summer cooling periods). With 5% shading loss, adding mass to the house leads to a decrease in heating load of 10% and a decrease in cooling load of 18%.

The conclusion we have reached -- that adding mass reduces energy load -- is at odds with the conclusion reached in the Passive and Active Solar Heating Analysis. This document asserts that moving from crawl space or full basement construction to slab-on-grade construction has a "negligible effect on the heating and cooling loads." 3/

There are two explanations for the difference between CECA's conclusions and DOE's. First, the BEPS analysis operated under the high shading loss assumption -- which tends to minimize the potential reduction in heating load due to the addition of thermal mass. Second, we added more mass to the house than DOE did. We utilized a six inch concrete slab for the high mass case; BEPS used a four inch slab. In DOE's analysis, assuming a 40% shading loss and a four inch slab, the heating load reduction would be roughly 3%, a smaller percentage than we observe for our base case.

3/ Passive and Active Solar Heating Analysis, p. 2-4.

We believe that the assumption of bad shading management is incorrect and the four inch slab is probably sub-optimal.

In our analysis, taking shading management and additional mass together, we observe a rather large reduction in energy load. The high mass case with proper shading management requires 18% less energy than the low mass case with a constant 40% shading loss. This reduction in energy load is essentially a passive solar contribution since it results from proper management of radiant heat.

2. Orientation

To gauge the additional potential contribution of solar to the reduction of energy use, an analysis was run which assumed that all the glass on the house faced south. In this case, there can be a very large reduction in energy use -- the high mass-shading-management case uses 34% less energy than the base case. However, for the south-facing case, proper shading management and adequate thermal mass are of special importance. Shifting from an even distributipn of glass to all south-facing glass in the low mass case reduces heating load by 9% for the 40% shading-loss case and by 7% for the 5% shading-loss case. In contrast, the heating load reduction in the high mass house is 22% for the 40% shading-loss case and 21% for the

5% shading-loss case. The simple fact is that with low mass, low shading and an even distribution of glass, the thermal capacity of the house is virtually exhausted. With low shading loss, for example, note that the low mass case with even distribution of glass has a lower heating load than the low mass-40%-shading-loss, all-south-facing case.

Similarly, shading management and thermal mass are important for cooling loads. The low mass-5%-shading-loss-all-south-facing case has a higher energy budget than the low mass-5%-shading-loss case with glazing distributed evenly due to the large cooling energy requirement. In contrast, the 40%-shading-loss-high mass house has a cooling budget almost as low as the lowest case with glass evenly distributed. Thus, shading management is crucial to effective solar houses.

The NCAT solar analysis also examines an intermediate case -- 50%-south-facing-glass -- which shows the importance of thermal mass (see Table V-2). The percentage reduction in heating load in the low mass case drops off very rapidly after the first 25% of the glass is moved to the south side. In the high mass case, the percentage reduction does not drop off nearly as quickly and then it stablizes.

In the NCAT analysis, the all-south-facing- high mass case with 5%-shading-loss proves to be just about an optimum

TABLE V - 2

THE EFFECTS OF SOUTH FACING GLASS AND THERMAL MASS ON HEATING LOAD

(North Omaha, 5% Shading)

	Heating Load (MMBTU)	% Reduction
Low Mass		
North	57.12	-
Even	49.01	14
50% South	46.55	5
ALL South	45.70	2
High Mass		
North	54.91	-
Even	44.23	19
50% South	39.02	12
ALL South	34.49	12

Source:

NCAT Analysis, see Appendix II, pages 9-12.

package (see Table V-3). The heating load declines steadily as glass is moved to the south side and bottoms out around 300 feet^2. It is worth noting that the passive solar analysis for Chicago with night insulation, carried out by DOE, reached 162 feet^2 on the south side . 4/ This is 92% of the total glass area of the prototype building. In Minneapolis, the same case reaches 252 feet^2 which is 140% of the total glass area of the prototype building. Thus, in these colder climates, maximum passive solar buildings would seem to require nearly all of their glass on the south side.

C. Conclusions

There are two central conclusions to be drawn from this brief analysis of solar potential. First, we recognize that moving all or even most of the glass to the south side of a building may entail an amenity loss, if having equal amounts of glazing on the four sides of a house is considered an amenity. However, we should also clearly recognize and emphasize that it entails a very significant economic gain as well. In our analysis, an optimum passive solar building with optimum shading management would have an energy load of approximately 37 MMBTU/yr. This is derived as follows: 34.49 MMBTU in heating taken from the all-south high-mass-5%-shading-loss case and

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4/ Passive and Active Solar Heating Analyses, pp. 2-20, 2-25.

TABLE V - 3

THE EFFECTS OF GLASS AREA ON HEATING LOADS

(High Mass, 5% Shading Loss)

Glass Area Sq. Ft. (South Facing)	Heating Load MMBTU/yr
0 1/	54.91
82 2/	44.23
164 3/	39.02
200 4/	37.22
300 4/	34.49
400 4/	34.04
500 4/	34.46
600 4/	35.25

Source:

NCAT Analysis, see Appendix II, pages 12-15.

1/ All north facing glass.
2/ 25% glass in each direction.
3/ 50% south, 25% east, 25% west.
4/ All south facing glass.

2.84 MMBTU/yr cooling, taken from the all-north-high mass-40%-shading-loss case. This is only suggestive of the true cooling load with 80% or 90% shading loss in the summer. In fact, cooling loads can probably be expected to go to zero. This constitutes a savings of roughly 22 MMBTU/yr. The present value of such savings, as will be discussed below, is between $4,000 and $16,000, depending on fuel choices and fuel prices.

The economic benefits of moving glass to the south side of a house can be so large that they should be spelled out clearly. DOE began with a framework that made it impossible to discover the full magnitude of these potential benefits. As we argued in the case of LCC analysis, a better approach is to explore the full range of possibilities so that a complete set of information is generated. Only with this complete information in hand can the trade-off between amenity costs and economic benefits be properly judged.

The second conclusion is that if solar is to be fairly evaluated, more reasonable and flexible assumptions will have to be made. DOE did analyze solar with night insulation and clearly acknowledges the important interaction between passive solar gain and night insulation. We have shown important interactions between solar energy, shading coefficients and thermal mass. What needs to be done is a complete and careful analysis of solar energy in its full complexity, so that potential benefits can be properly calculated.

D. Recommendations

The Consumer Energy Council of America recommends that in the next round of research DOE devote as much attention, dollar for dollar and time for time, to non-depletables as to conventional conservation. Furthermore, in order to fulfill its clear legislative mandate, DOE should set the energy budget levels so that nondepletables will truly be encouraged. Specifically, we suggest that the budget be set at conventional conservation plus "optimum passive solar." The law demands maximum practicable improvement in energy efficiency and increases in the use of non-depletable energy sources It does not say or increases in the use of nondepletable energy sources. There are no or's or but's about Congress' intent in this regard.

We suggest an approach that would not make the use of a solar energy conservation option mandatory, but would make it very attractive. The nominal BEPS building would be the starting point. However, in order to meet the stricter standard which we propose, one of two solar options could be applied. One would involve optimum passive solar coupled with the mechanical devices necessary to make it most effective. A second would be a choice of active solar systems. These would not be the only options. Several conventional routes would be open as well and there would be potential trade-offs, but at a much lower level of energy use and higher level of conservation than now proposed by DOE.

In reviewing the series of packages that we recommend to meet this much stricter standard, it doesn't take a professional economist to recognize that one of the most cost effective options is likely to be passive solar. In this way, the use of solar energy would be truly encouraged.

In addition to the economics of solar energy and the strong legislative mandate for its encouragement, there is another reason to structure the standards to encourage passive solar systems. Passive solar as a conservation option is nearly the most difficult item for which to retrofit. If the glass on a building is facing the wrong way, it is very difficult and very expensive to move it around. We believe that one criteria for evaluating the efficiency of a house is its retrofit capability.

Having built up a stock of inefficient homes, the nation is currently suffering the agony of having to retrofit. Though it is impossible to predict all future developments, BEPS should be sufficiently forward looking not only to improve the performance of buildings as they are built, but to optimize their future potential and adaptability.

Over the realistic 60 year life of the building we must expect that houses built according to BEPS in the early years will be retrofitted before they are retired. If they are built with that in mind, difficulties can be minimized. Since passive solar heat gain is the most difficult characteristic to retrofit in the future, it should be optimized in the present.

This is a straightforward principle -- optimize in the present those factors that are least amenable to future modification -- a principle which is quite consistent with the legislative mandate to achieve maximum practicable improvement in energy efficiency. An optimum passive solar house built today can more easily accommodate other conservation measures than vice-versa and, over the true life of the building, it is much more likely to achieve maximum efficiency in energy use.

CHAPTER VI

SETTING ENERGY BUDGETS FOR COMMERCIAL BUILDINGS

A. General Methodological Problems

There is a certain sense in which the methodology applied to the commercial sector does not merit criticism. It was so ill-conceived and poorly executed that it has not even begun to suggest the levels of conservation that are attainable.

1. CECA believes that the fundamental conception of the methodology for commercial buildings was seriously flawed. A redesign exercise is not the best approach for discovering what constitutes maximum practicable improvement. To be precise, taking the average architect in the mid-1970's, giving a couple of days of energy conservation lectures, placing constraints on the options allowed and asking the architect to produce energy efficient buildings hardly seems conducive to discovering "maximum practicable improvement."

Even with the constraints placed on the redesign architects (especially the restriction of cost and certain solar options), 70% of the architects used conservation options that were ruled out of bounds (about one half of these were solar). The budgets which DOE has published do not reflect these. Thus, these budgets reflect even less than what the average architect could achieve. A full critique of DOE's concept of maximum practicable is presented in Chapter IX.

2. The sampling procedure used to develop the data base was far from adequate. In the original survey of buildings, the response rate was only 50%. No non-response follow-up was undertaken. The selection of a subsample for the redesign exercise was equally unsystematic, resulting in a sample of 168 buildings designed by architects who were highly self-selected. This sample of 168 buildings is not even representative of the respondents, not to mention the original sample population or the entire universe. Of the 15 categories of buildings analyzed, only four (large offices, gymnasiums, shopping centers and hotels) show no significant differences in any of the energy use categories (heating, cooling, lighting, fan, total BTU) between the Phase II respondents and non-respondents (see Table VI-1). The Statistical Analysis glosses over the problem, but it is quite real and needs to be addressed.

B. The Lack of Economic Analysis

DOE took the midpoint of the redesigns (except for office buildings which were set at a lower level of energy use and hospitals and multifamily low rise buildings

TABLE VI - 1

SIGNIFICANT DIFFERENCES BETWEEN PHASE I AND PHASE II BUILDINGS, BY BUILDING TYPE AND ENERGY USE

(* Indicates significant t)

Building Type	Energy Use Heating	Cooling	Lighting	Fan	Total BTU
Small Office				*	
Large Office					
Elementary School	*	*	*	*	*
Secondary School	*	*			*
Hospital	*		*		
Clinic		*	*		*
Gymnasium					
Theater		*	*		*
Community Center	*				*
Stores		*			*
Shopping Center					*
Warehouse	*	*			*
Nursing Home					
Hotel/Motel					
High Rise Apt.			*	*	*

Source:

Statistical Analysis: Table A, pp. A-47 thru A-51.

best copy available

which were set somewhat higher) which rested on this weak data base and compounded the weaknesses of the methodology by failing to do a full economic analysis.

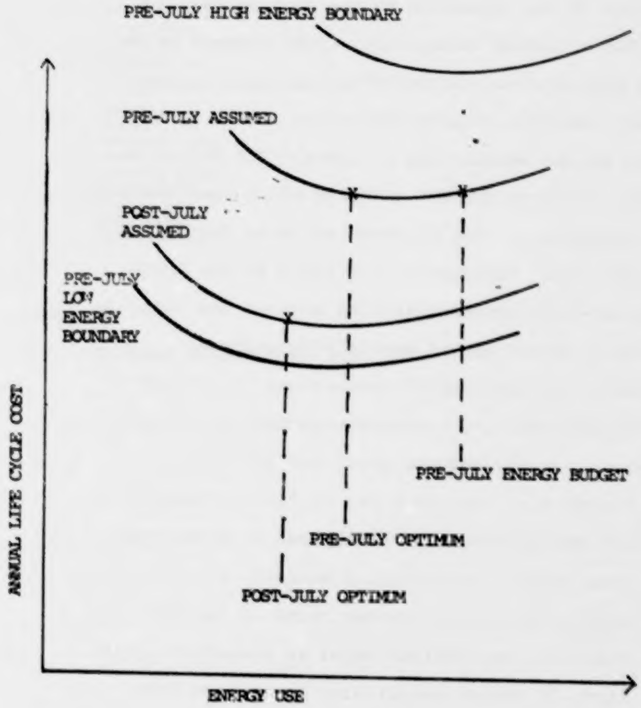
1. The only categories of buildings for which LCC analysis was done -- office buildings -- showed such high economic benefits that the budgets were lowered from the 50th percentile of the redesigns to the 30th percentile.

2. For all other categories, a net present value analysis was done on either the 50th or 70th percentile redesign energy budget. However, this analysis was flawed by the failure to do proper sensitivity analyses. DOE failed to do sensitivity tests on the NPV analysis which used the post-July, 1979 assumptions. The argument was made that since the sensitivity runs conducted on the NPV analyses which embodied the pre-July assumptions also bounded the post-July analysis, a second set of sensitivity analyses was unnecessary. In fact, this misconstrues the intent of sensitivity analysis and misrepresents the "soundness" of the commercial energy budgets which DOE has set.

Figure VI-1 depicts a set of flat bottomed LCC curves which approximate the actual case of commercial buildings. Even though the post-July economic analysis is just barely within the low-energy-use bound of the pre-July sensitivity analysis, the optimum point is missed by a wide margin. In fact, if proper sensitivity tests were done

FIGURE VI-1

COMMERCIAL BUILDING ENERGY BUDGETS AND SENSITIVITY ANALYSES



Source:

CECA

for the true optimum point suggested by the post-July analysis, the actual energy budgets set by DOE would probably not even fall within the sensitivity range on the high side. If more realistic fuel prices, similar to CECA's estimates, were used, DOE's budgets wouldn't even be close to the high energy price boundary.

Table VI-2 shows this error in numerical terms. The post-July NPV's are very close to the pre-July sensitivity test with high fuel price escalations. The margin for error on the low side is ridiculously large. Fuel prices would have to decline dramatically from their current levels before the economic justification for the investment in conservation would be even vaguely threatened. That prospect is not very likely. Put another way, the costs of conservation would have to rise even more dramatically before the economics of this investment were threatened. On average, capital costs would have to be roughly 10 times higher than the BEPS estimates before NPV of the investment goes to zero.

If sensitivity analysis means anything, it means that chosen strategies should be located reasonably within safety zones. For the commercial budgets, the sensitivity analyses suggest that they are far too high. Given the reality of fuel prices and the likelihood that capital costs have not been underestimated by anywhere near a factor of

TABLE VI-2

SENSITIVITY ANALYSES RESULTS, NET PRESENT VALUES

Building Type	Pre-July NPV $/Sq. Ft.	Fuel Price: Low Fuel Price Escalation	Fuel Price: High Fuel Price Escalation	Increase in Capital Costs: 10% Increase	Increase in Capital Costs: 20% Increase	Post-July NPV $/Sq. Ft.	% Increase in Capital Cost at Which NPV=0 Post-July	Conservation Cost as a % of Total Cost where NPV=0
Assembly	0.73	0.21	1.24	0.62	0.51	1.05	117	12.5
Clinic	1.44	0.89	2.00	1.36	1.28	1.75	194	7.8
Hospital	3.39	2.13	4.66	3.19	2.29	4.07	204	8.5
Hotel/Motel	1.84	1.32	2.35	1.70	1.55	2.09	149	.5
Mercantile	1.26	0.72	1.80	1.20	1.14	1.58	257	20.1
Nursing home	1.02	0.44	1.60	0.82	0.62	1.38	69	7.9
Large office	0.99	0.54	1.44	0.94	0.88	1.26	252	13.8
Small office	0.85	0.23	1.48	0.70	0.58	1.26	84	13.3
Restaurant	3.08	1.87	4.29	2.64	2.21	3.75	85	4.5
Elementary school	0.34	0.04	0.72	0.24	0.13	0.59	59	7.4
Secondary school	1.36	0.82	1.91	1.11	0.90	1.67	64	3.4
Warehouse	0.81	0.43	1.21	0.77	0.72	1.04	260	22.2
High-rise	1.64	1.41	1.86	1.49	1.35	1.68	112	12.9
Low-rise	-0.06	-0.24	0.13-	-0.11	-0.20	0.09	13	8.3
ALL BUILDINGS	1.32	0.74	1.90	1.18	1.03	1.67	119	7.9

Source:

Economic Analysis, Table 4-22 and 4-24.

10, the conclusion would be that much more capital should be invested in conservation. Since there are declining marginal returns to conservation investment, it is difficult to say exactly how much more should be invested. However, some indication can be gleaned from the life cycle cost analysis of office buildings. Note in Table VI-2 that office buildings were below average in the rate of return on conservation investment. Yet, the LCC analysis for these types of buildings showed that additional investment was extremely cost effective. In fact, levels of investment 50% greater than those required to meet the strict standards were cost-justified and they yielded a reduction in energy use of 15% in Raleigh, N.C., 30% in Minneapolis and 24% in Denver. Keeping in mind that the other commercial buildings were set at the nominal rather than the strict level, it would appear that most of the commercial energy budgets are probably 50% higher than they could have been set. Consequently, very significant amounts of energy conservation have been foregone.

Finally, let no mistake be made about the consumer's interest in having commercial energy budgets set at a reasonably strict level. The cost of energy inefficient buildings will undoubtedly be passed on to the consumer in the form of higher prices for goods and services.

Given the extremely wide margin by which the commercial budgets appear to be above the optimum, we can only conclude that if buildings are actually built to those budgets, the consumer would pay a very high and unnecessary price.

CHAPTER VII

THE IMPACT OF FUEL PRICE INCREASES ON THE VALUE OF ENERGY CONSERVATION

A. Fuel Price Estimates

Appendix I of this report presents a detailed analysis of the fuel price projections used by DOE in the BEPS analysis. The conclusion reached is that DOE has significantly underestimated fuel price trends. Furthermore, with respect to the life cycle cost and other economic analyses, the starting prices for DOE's analyses are too low. The combined impact of a low starting point and a low rate of escalation leads to a significant underestimation of the potential benefits of energy conservation. The analysis in Appendix I is done in general dollar terms, rather than in the specific cost/MMBTU terms that BEPS uses. In this chapter, we examine the impact upon each aspect of the BEPS program of using fuel price projections that are far too low.

The BEPS analysis has underestimated the present value of saving a million BTU's of energy by between 100% and 200% (see Table VII-1). Whereas DOE's Economic Analysis uses a present worth factor of $99/MMBTU for gas, CECA estimates that a correct present worth factor for gas should be between $200/MMBTU (starting price =$4.68/MMBTU; fuel

TABLE VII - 1

THE IMPACT OF INITIAL PRICE DIFFERENCES AND ESCALATION RATE DIFFERENCES ON THE PRESENT VALUE OF FUEL SAVINGS*

	Initial Price $/MMBTU,1981	Escalation Rate (real%)	Present Value $/MMBTU
GAS			
BEPS*	3.42	2.81	99.7
BEPS	4.68	2.81	136.4
CECA Low Trend	3.42	8.00	221.5
CECA Low Trend	4.68	8.00	303.0
BEPS-CECA Aug. Trend	3.42	5.41	146.4
BEPS-CECA Aug. Trend	4.68	5.41	200.31
ELECTRICITY			
BEPS*	12.90	1.54	312.46
BEPS	19.34	1.54	468.74
CECA Low Trend	12.90	4.7	495.58
CECA Low Trend	19.34	4.7	742.99
BEPS-CECA Aug. Trend	12.90	3.1	387.51
BEPS-CECA Aug. Trend	19.34	3.1	580.96

Source:

Economic Analysis, App. A, pp. A-38 thru A-39.
(All analyses reflect a 3% real discount rate).

* The equation used for present values in the CECA analysis is:

$$PV = S \sum_{1}^{n} \frac{\left(1 + \frac{1+P}{1+d}\right)^{n} - 1}{\frac{1+P}{1+d}}$$

where: S= first year fuel savings in dollars,
n= 30 years
P= real price escalation ra
d= real discount rate

Using the original BEPS numbers this equation produces an estimate of PV for gas of $99.8/ MMBTU and $316.9/MMBTU for electricity. Thus it differs from the BEPS calculation by less than 2%. The difference is due to a difference in the approximating equation.

escalation rate = 5.41% real which is the average of the CECA low trend and the BEPS trend) and $303/MMBTU starting price = $4.68/MMBTU; fuel escalation rate = 8% real which is the CECA low trend). 1/ Roughly 50% of the increase in present value is attributable to the higher starting point and 50% is attributable to the higher escalation rate.

For electricity, the BEPS analysis used a present value of $312/MMBTU, whereas CECA estimates the present value to be between $580/MMBTU and $743/MMBTU. 2/ Here the higher initial cost of fuel accounts for roughly 60% of the increase in present value.

To put this in other terms, even if the BEPS escalation rates are correct, which is highly uncertain, the underestimation of the initial price which _is_ certain would lead to an underestimation of the present value of gas of 37% and of electricity of 47%. Normally, we would use the adjusted starting point, coupled with the BEPS escalation rates, as a low estimate of the present value of fuels, but the BEPS escalation rates are just too unrealistic. Thus, we have chosen to couple the adjusted starting price

---

1/ The starting price is derived by taking the 1979 price of gas and escalating it at 20% (nominal) for two years. (See Appendix I).

2/ The starting price is derived by taking the 1979 price of electricity and escalating it at 16.7% (nominal) for two years. (See Appendix I).

with a CECA/BEPS average trend for the low estimate and with the CECA low trend for the high estimate. We believe that these are more realistic price estimates.

B. The Value of Conservation

Underestimating the present value of fuel savings by 100% to 200% has a tremendous impact on the economic analysis. Most of the conservation options that were ruled out because they were uneconomic should now be ruled in because they are economically justified. There is a caveat to this conclusion. The costs of conservation measures were also underestimated in the BEPS analysis, although not nearly as much as fuel prices.

We do not have alternative estimates for costs of conservation. Therefore, we have taken a cautious approach to our reanalysis of the economic data. We have calculated the present value of energy conservation options considered in the BEPS analysis in one of two ways. Where cost data was available, we have calculated the present value of fuel savings/MMBTU at which net present value would be zero. These figures can be compared to the present values that we estimate for each fuel. Where our estimates of PV are greater than those PV's where NPV = 0, the investment would be cost-justified. The difference between our estimated PV's and PV-where-NPV = 0 can be used either as a rule of thumb for the margin for error, i.e., how much conservation costs would have to rise before the investment would not be cost-justified, or as a rule of thumb to estimate the dollar return that would be realized from the investment (assuming conservation costs were properly estimated). The reality probably lies someplace between these two rules of thumb, i.e., some of the difference would be eaten up by increased conservation costs; much of it would be returns on investment. Where we have no cost estimates whatsoever, we simply project the range of present values that might be reaped as a return on the investment.

1. Conventional Conservation Techniques

Let us begin with nominal BEPS (see Table VII-2). It can be seen that the present value of setting conservation at the level of nominal standards has been underestimated by many thousands of dollars. On average, the present value of fuel savings in the gas heated houses has been underestimated by between $2,000 and $3,500, while for electrically heated houses it has been underestimated by between $3,000 and $5,000. Insofar as we believe that the levels of conservation embodied in these nominal BEPS houses are far too low, the very high present value figures have one important implication. With respect to the building industry's complaint that real conservation costs are higher than those used in the BEPS analysis,

TABLE VII - 2

THE PRESENT VALUE OF FUEL SAVINGS AT NOMINAL BEPS STANDARDS

(in $, 3% real discount rate)

	Gas Heat			Electric Heat		
	BEPS PV	CECA PV. Low	CECA PV. High	BEPS PV	CECA PV. Low	CECA PV. High
Minneappolis	2834	5647	8489	5996	11149	14258
Chicago	1970	3929	5890	4718	8773	11219
Portland	1896	3801	5752	4587	8529	10907
Wash. D.C.	1547	3056	4489	3400	6321	8084
Atlanta	1920	3825	5717	4793	8912	11398
Fresno	1804	3560	5220	4121	7663	9800
Burbank	432	859	1263	1481	2754	3522
Phoenix	1941	4707	5065	2753	5119	6546
Houston	1053	2057	2952	2956	5496	7029
Ft. Worth	2322	4532	6481	4074	7576	9689
Avg.	1772	3597	5134	3889	7229	9245

Source:

Economic Analysis, Tables A-11, A-12, pp. A-42, A-43.

these figures clearly show that there is a great deal of room for error. DOE used an average cost of conservation of $900 for gas heated homes and $1,100 for electrically heated homes. Even if actual conservation costs were triple the DOE estimate, our PV's suggest there would still be a large economic return on the investment. Even if we triple conservation costs and use the low estimate of present value for fuels, the absolute value of the return on the investment (though not the rate of return) would still be as large as in the original DOE analysis. A great deal more expenditure and conservation is clearly cost-justified.

Since the nominal BEPS houses are essentially conventional conservation approaches taken part of the way toward their optima, we next turn to the economics of additional insulation. As part of the energy budget selection, DOE considered additional insulation which would reduce energy consumption by, on average, 8%. None of these strategies were found to be cost-effective. However, using CBCA's estimates of present value (see Table VII-3), this strategy appears cost-justified in every case. With one or two exceptions, the margin for error is large -- a doubling or even tripling of the cost of conservation would not undermine the cost-effectiveness of the conservation measures.

TABLE VII - 3

THE ECONOMICS OF ADDITIONAL INSULATION
(Gas Heated Houses)

	Cost ($)	Energy Reduction (MMBTU/yr)	Present Value of Fuel savings where NPV=0* ($/MMBTU)
Minneapolis	733	4.2	173
Chicago	295	2.9	102
Portland	295	2.2	134
Washington, D.C.	295	2.0	148
Atlanta	427	4.4	97
Fresno	427	4.7	91
Burbank	139	1.5	91
Phoenix			
Houston	242	2.6	93
Ft. Worth			

Source:

Energy Budget Level Selection, App. H , Table 4., pg. H-21.

*For purposes of comparison CECA's estimates of the present value of fuel savings per MMBTU are:

Gas	$200-303
Electricity	$581-743

Along these same lines, CECA commissioned a study of super-insulation -- walls to R-50, ceilings to R-70 (see Appendix II). Using our projections for the present value of fuels, these options are clearly cost-justified in colder climates, i.e., climates with 6000 or more heating degree days (see Table VII-4). Our estimated costs of construction for these super-insulated options are taken from the National Construction Estimator, which is quite realistic. Thus, one can have considerable confidence that the actual error is small and the benefit of these measures is achievable.

One must recognize that at these levels of insulation we are probably close to the point where declining marginal returns for extra insulation have set in and there might be amenity costs to heavily insulated walls and ceilings. Other conservation options would probably be chosen before these. However, from the point of view of doing a complete economic analysis which sets a proper framework for making policy decisions, the fact that even extreme levels of insulation are cost-justified underlines the necessity of not placing constraints on the LCC analysis. Moreover, from the point of view of defining a set of packages to meet a stricter standard, the fact that super-insulation

TABLE VII - 4
THE ECONOMICS OF SUPER INSULATION

(Net Present Value $/ Sq. Ft. (Assuming Present Value 2 Times Greater than the Post-July Assumptions)

# Degree Days	Wall Insulation			Ceiling Insulation		
	R30	R42	R53	R49	R60	R71
800 Degree Days						
Gas	1.15	1.45	1.54	—	—	—
Electric	4.19	2.11	5.54	.66	1.00	1.14
6000 Degree Days						
Gas	.51	.69	.72	—	—	—
Electric	2.69	3.43	3.72	.36	.46	—
4000 Degree Days						
Gas	-.13	-.07	-.12	—	—	—
Electric	1.39	1.75	1.88	—	—	—

Source:

NCAT Analysis, see Appendix II, page 17, page 21.

is cost-justified establishes it as one possible alternative.

DOE has chosen as its primary approach to strict budgets a series of steps to reduce air infiltration In the original analysis, these steps were cost-justified. Using our price projections, they become extremely cost-effective (see Table VII-5), with very large differences between PV where NPV = 0 and CECA's projected PV's. In fact, low infiltration appears to be the most cost-effective of all the conservation measures.

The owner-operated devices (see Table VII-6) also show rather high present values. Night insulation would be extremely cost- justified since it is a low cost item. Heat shutters tend to be considerably more expensive.

A final point that should be recalled is that for commercial buildings DOE has missed the optimum point of energy conservation by a wide margin. With the estimates of the present value of fuels that we have developed, the budgets for commercial buildings are so far from the optimum that the nominal budgets are entirely unrealistic.

2. Solar Energy Options

Solar energy approaches to conservation also appear to be cost-effective in light of the higher fuel costs that we project. For the active solar options, the results

TABLE VII - 5

THE ECONOMICS OF LOW INFILTRATION

	Cost($)	Energy Reduction (MMBTU/yr)	Present Value of Fuel Savings Where NPV=0 * ($/MMBTU)
Minneapolis	500	29.3	21
Chicago	500	15.1	33
Portland	500	10.9	46
Washington	500	10.1	50
Atlanta	500	6.9	80
Fresno	500	10.6	47
Burbank			
Phoenix	500	3.5	143
Houston			
Ft. Worth	500	6.4	94

Source:

Economic Analysis , cost figures, pg. 4-29; energy reduction figures, Table 4-9, pg. 4-31.

*For purposes of comparison CFCA's estimates of the present value of fuel savings per MMBTU are:

Gas	$200-303
Electricity	$581-743

TABLE VII - 6

THE ECONOMICS OF OWNER OPERATED CONSERVATION DEVICES

	Heat Shutters			Night Set Back		
	Energy Savings* MMBTU/yr	Present Value ($)** Gas	Present Value ($)** Electric	Energy Savings** MMBTU/yr	Present Value ($)*** Gas	Present Value ($)*** Electric
Minneapolis	2.5	500-758	145-1858			
Chicago				2.9	580-879	1685-2155
Portland						
Washington, D.C.	1.4	280-424	813-1040			
Atlanta				1.6	320-485	930-1189
Fresno	1.6	320-485	930-1189			
Burbank				1.3	260-394	755-966
Phoenix						
Houston						
Ft. Worth	1.5	300-454	272-1115			

Sources:

*Economic Analysis, Table A-5, pg. A-26.

**Economic Analysis, Table A-4, pg. A-24.

***For purposes of comparison CECA's estimates of the present value of fuel savings per MMBTU are:

Gas	$200-303
Electricity	$581-743

are somewhat mixed (see Table VII-7). With respect to electricity, every form of active solar option, except high cost space-heat-only systems, would be cost-justified in all climates at the low estimate of PV. Even the high cost space-heat-only options would be cost-justified at the high PV estimate for electricity.

For gas, it is difficult to say exactly what the prospects are because the system should be "reoptimized" with new fuel prices. However, to gain a rough idea of the potential for active solar with respect to gas we can project from the houses optimized against electricity. This is possible since PV's used for the original electricity optimizations are close to those we project for gas. Moreover, the gas energy budgets are higher to start with, thereby providing greater room for improvement.

We conclude that active space and hot water systems appear to be close to cost-justified. The necessary PV's are close to our high estimate for the PV of gas. The hot-water-only systems tend to require PV's at or below our low estimate for the PV of gas. Thus, they are certainly cost-justified. All of these calculations are without tax credits. If these are factored in, the active solar systems would easily be cost-justified. In fact, with tax credits the active space-plus-hot-water-systems and the hot-water-

Table VII - 7

THE ECONOMICS OF ACTIVE SOLAR SYSTEMS

(PV of fuel at which NPV=0 ($/MMBTU))*

	Space Heat Only (Electric)	Space and Hot Water Heating (Electric)	Hot Water Heating Only (Electric)	Hot Water Heating Only (Gas)
Minneapolis	331	270	221	157
Chicago	427	298	232	169
Portland	677	324	282	201
Washington, D.C.	708	331	247	204
Atlanta	618	302	235	180
Fresno	475	294	220	112
Burbank	661	294	210	144
Phoenix	650	334	207	141
Houston	1407	374	259	204
Ft. Worth	694	304	230	171

Source:

Passive and Active Solar Heating Analyses, Tables 3-2, 3-3, 3-4, pp. 3-7 thru 3-9.

* For purposes of comparison CECA's estimates of the present value of fuel savings per MMBTU are:

Gas	$200-303
Electricity	$581-743

only systems become not only cost-justified, but cost-competitive with many of the conventional conservation options.

Free passive solar, i.e., passive solar gain achieved by moving all of the north facing glass to the south side, becomes quite valuable given our estimate of the present value of fuel savings (see Table VII-8). On average, 3 MMBTU can be saved by using this option. The present value of such an option ranges from a low of $418 (Houston = 2.04 MMBTU @ $200/MMBTU) to a high of $2,950 (Minneapolis = 3.47 MMBTU @ $743 MMBTU). With proper shading management and optimum thermal mass, the savings would be even greater.

DOE took two other approaches to the passive solar analysis. One approach was to optimize the passive aperture against electricity as the competing fuel with and without night insulation. It is difficult to translate these results into the terms we have been using. However, it should be noted that the present value of electricity used in those analyses was between $249 and $286 (except for Portland) so that they are between our high and low gas estimates for the gas PV. In every case, additional glass was added to the south face. Further, the first 44 feet of additional glass on the south side was not taken for free,

TABLE VII - 8

THE ECONOMICS OF FREE PASSIVE SOLAR ENERGY CONSERVATION:
Net Present Value of Placing 50% of the Glazing On the South Face

	Savings in MMBTU *	Gas Heat **		Electric Heat ***	
		Low	High	Low	High
Minneapolis	3.97	794	1203	2307	2980
Chicago	3.36	672	1018	1952	2496
Portland	3.19	638	967	1853	2370
Washington	2.87	574	870	1667	2132
Atlanta	3.07	614	930	1784	2281
Fresno	2.91	582	882	1691	2162
Burbank	2.34	468	709	1360	1739
Phoenix	2.43	486	736	1412	1805
Houston	2.09	418	633	1214	1553
Ft. Worth	2.61	522	791	1516	1939

Source:

* *Passive and Active Solar Heating Analysis*, Table 4-1, pg. 4-3.

** CECA's estimates of the present value of gas per MMBTU are $200- $303.

*** CECA's estimates of the present value of electricity per MMBTU are $581-$743.

i.e., by moving it from the north side. We can only conclude that the optimum passive solar system, even with gas as a competing fuel, would have a very large aperture and lead to a very large reduction in the use of conventional fuel for heating and cooling.

Our calculations for buildings with all the glass on the south side show that they "optimize" without adding much glass. The North Omaha (6000 degree days) high-mass house optimizes at roughly 300 square feet, which is less than the total amount of glass in the original design. The Bismark (9000 degree days) high mass house optimizes at roughly 400 square feet, which requires adding only 71 square feet of glass. Assuming proper shading management, the savings in heating load are 10 MMBTU against the base case in North Omaha. The present value would be $2,000 at the low estimate for gas and $7,430 at the high estimate of electric PV. In Bismark, the energy savings are 18 MMBTU, with a present value of $3,600 at the low estimate for gas and $13,374 at the high estimate for electric. Even if we assume that these buildings require a full addition of mass, i.e., the base case is extremely low in mass, the total incremental cost in North Omaha is $2,400 and the total incremental cost in Bismark is $5,000. Thus, the all-south-facing cases appear to be easily cost-justified. The addition of night insulation tends to make such systems even more economically cost-justified.

DOE took a second approach to passive energy savings. The cost of decreasing the energy budget of a gas heated house by 20% with solar options was calculated and compared to the value of the fuel saved. By and large, the investment was not cost-justified. However, using CECA's PV estimates, almost all of the cases would be cost-justified (see Table VII-9). Moreover, it seems that DOE has performed this analysis without moving any of the existing glass. At least the first 44 feet should be taken for free, by moving it from the north side. Under this assumption, passive solar becomes "free", except for the addition of thermal mass, in all climates as warm as or warmer than Atlanta.3/ The cost of thermal mass is probably no greater than one half the total system cost, so that in these warmer climates a 20% contribution of direct gain passive solar would be easily cost-justified (except for Burbank). In colder climates, where additional "nonfree" south facing glass is required, the systems are cost-justified even without taking the first 44 square feet for free.

C. Conclusion

By now, the message should be abundantly clear. The

3/ To arrive at this conclusion, compare the 20% solar gain analysis with the North-South solar analysis. Energy Budget Level Selection pp. H-17 thru H-20.

Table VII - 9

THE ECONOMICS OF PASSIVE SOLAR
(Reducing a Gas Heat Budget by 20% with Direct Gain Passive Solar)

	Cost	Energy Savings MMBTU	Present Value of Fuel Saved at Which NPV=0 * ($/MMBTU)
Minneapolis	1323	12.8	103.4
Chicago	945	8.2	115.2
Portland			
Washington, D.C.	1323	5.3	249.6
Atlanta	567	4.4	128.9
Fresno	1134	3.8	298.4
Burbank	1323	1.6	826.9
Phoenix			
Houston	1323	3.5	378
Fort Worth	1323	3.5	378

Source:

Energy Budget Level Selection, Appendix H, Table 2, pg. H-18.

*For purposes of comparison, CECA's estimate of the present value of fuel savings per MMBTU of gas is $200-$303.

economics of conservation show very large potential benefits. In fact, there is no longer any doubt about the economic justification of investment in any of the conservation measures. Economics has ceased to be a constraint on conservation.

CHAPTER VIII

WEIGHTING FACTORS AND FUEL CHOICE

Another important issue which needs to be addressed before CECA makes its final recommendations on the standards deals with weighting factors. CECA believes that it was a mistake for DOE to try to build houses around the fuels they are likely to burn and it was equally wrong to try to influence the choice of fuels through weighting factors. Our objection to the use of weighting factors stems from a fundamental disagreement with the principles behind weighting factors as well as from practical difficulties in setting weights.

A. Matters of Principle

1. It is certainly not clear in the legislation that DOE had to place weighting factors on the various conventional fuels. One can easily interpret the findings of Congress to mean that the objective should be to reduce energy use within the building boundary.

> The Congress finds that...Large amounts of fuels and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings because such buildings lack adequate conservation features...1/

1/ Energy Conservation Standards Act.

Under this interpretation, the BTU's consumed in the building are essentially equal, i.e., independent of the fuel which produced them.

DOE's original RIF/RUF approach interpreted the Congressional mandate in a broader fashion to include source energy as well. The shift to an economic base for weighting factors also embodies the concept of source energy and other social costs. As justification for this broad approach to weighting factors, DOE cites the Industrial Fuel Use Act and the National Energy Plan. CECA believes that this was a mistake which seriously detracts from the program.

We believe that BEPS should reflect one central national energy policy -- the decision to conserve energy in buildings -- and not try to reflect or make national energy policy with respect to the choice of fuels to be used. The simple fact is that the weighting factors as proposed by BEPS actually contradict national energy policy as it now stands. Insofar as it discourages electricity, it discourages a primary use of coal and virtually the only use of hydro power and nuclear energy.

Part of the problem is that national energy policy has changed, a change for which the BEPS program is not responsible, but that is exactly the point. Buildings are major, long-term, relatively fixed investments which cannot be easily changed to reflect national energy policy. In the course of the 60 year life of a building, national energy policy with respect to fuel choice will probably change a number of times; the buildings constructed to meet BEPS will not. The safest path is to optimize conservation independently of fuel choice policy. It is entirely possible to design energy efficient buildings without reference to fuel choice.

In other words, two separate decisions can be made, each with its own criteria. First, we can decide how much energy should be used in the building; then we can decide which fuel to burn in order to produce the energy. BEPS can address the first decision and leave the second to other national policies (such as price and subsidy policy) or to other decision-makers (such as consumers and builders).

2. With respect to the first decision -- how much energy to use in a building -- fuel prices are not the best criteria around which to optimize. The life of a fuel system is roughly one-third the life of a building shell. The fuel system can be changed more easily than the shell and relative fuel prices are very volatile. If the shell is tailored to fit the fuel system, the chances of achieving optimum energy efficiency over the life of the building are reduced. This is the same principle stated with respect to

passive solar energy -- optimize in the present what is least amenable to change in the future. Since building shells are less flexible than fuel systems, any attempts to optimize should give precedence to shells over fuel systems.

3. Focusing the design of the building on the fuel choice also creates problems of equity (at least insofar as DOE has failed to take conservation to the LCC optimum for each fuel type). As it now stands, individuals are allowed to consume different amounts of energy depending upon the fuel that they choose to burn.

In essence, what DOE's methodology tries to do is equalize fuel bills between individuals (although because of the restrictions placed on the LCC analysis, it doesn't even achieve that goal) rather than energy use. One alternative, and we believe superior, approach to equity is to set a standard which establishes a uniform maximum amount of energy (adjusted for climate) that individuals are allowed to consume for the space and hot water conditioning of new buildings. The individual, i.e., builders and consumers, can then choose which fuel to burn in order to produce that energy on the basis of those factors which are important to the individual. The BEPS analysis assumes that only fuel prices (variable costs) matter to the individuals, but we believe that a great deal more goes into the choice of fuel system, including, but not limited to, system cost (capital and maintenance), convenience and certainty of supply of the fuel.

The approach we are suggesting with these principles is that BEPS concentrate first on determining the level of energy use in a maximally practicable energy-efficient building. This will define the level of energy conservation that is to be achieved, which is the central purpose of the program. Then, DOE can perform micro-economic analyses of this basic, energy conscious building. Those analyses would take fuel choice -- system cost, system efficiency and fuel prices -- into account, showing where more conservation measures beyond BEPS are justified, where economic returns are highest, etc. The secondary decision of fuel choice would be made (by builders and consumers) after the primary decision -- the maximum level of energy conservation -- had been made by DOE.

In addition to these objections to weighting factors, based on our general approach to the setting of budgets, we believe that there are practical obstacles to using weighting factors that would make them impossible to apply in an effective fashion.

B. Practical Considerations

1. There are huge variations in energy prices between regions and over periods of time. DOE has

acknowledged this problem and has indicated its intention to address it. However, CECA thinks that it has grossly underestimated the difficulty of trying to fine tune a program such as BEPS to relative, regional fuel prices. Table VIII-1 shows that for the 27 SMSA's for which data were available for both November 1978 and October 1979, in November 1978, the ratio of electric to gas prices per MMBTU varied from 1.42:1 in Seattle to 7.78:1 in Los Angeles. The national average was 4.95:1. Therefore, regional weighting factors would cause a great deal of variation in energy budgets.

Of greater importance is the problem of changing relative prices. By October 1979, the relative prices had altered considerably. The national average had declined to 4.45:1. In 20 cities the ratio of electric to gas prices had declined; in seven cases it had increased. The largest decrease was in San Francisco, from 6.10:1 to 3.73:1 (a decline of 39%). The largest increase was in Dallas, from 4.55:1 to 5.34:1 (an increase of 17%).

These problems exist with actual, average, relative, regional prices. One shudders to think of the difficulties involved in projected, marginal, relative, regional prices, which DOE suggests are the proper basis for weighting factors.

TABLE VIII - 1

RELATIVE PRICES ($/MMBTU) BY CITY WITH GAS EQUAL TO ONE

	NOVEMBER 1978			OCTOBER 1979		
	Gas	Oil	Electric	Gas	Oil	Electric
U. S. City Average	1	1.38	4.95	1	1.76	4.45
Chicago	1	1.38	5.42	1	1.72	4.29
Detriot	1	1.33	5.81	1	1.91	5.26
Los Angeles	1	NA	7.78	1	NA	5.38
Philadelphia	1	1.0	4.73	1	1.19	4.06
Anchorage	1	1.35	5.70	1	2.38	6.24
Baltimore	1	1.03	4.78	1	1.46	4.25
Boston	1	0.99	3.63	1	1.44	4.19
Cincinnati	1	1.28	4.46	1	1.92	4.16
Denver	1	NA	5.54	1	NA	4.06
Miami	1	NA	4.44	1	NA	4.40
Milwaukee	1	1.24	3.73	1	1.78	4.40
N.E. Penn.	1	0.97	3.65	1	1.52	3.60
Portland	1	0.91	2.39	1	1.34	1.89
St. Louis	1	NA	4.90	1	NA	3.82
Seattle	1	1.01	1.42	1	1.44	1.25
Wash, DC	1	.99	3.46	1	1.50	3.93
Atlanta	1	NA	4.29	1	NA	4.01
Buffalo	1	1.29	4.09	1	1.60	3.51
Cleveland	1	NA	6.51	1	NA	5.94
Dallas	1	NA	4.55	1	NA	5.34
Honolulu	1	NA	2.06	1	NA	1.59
Houston	1	NA	NA	1	NA	4.40
Kansas City,M	1	NA	6.60	1	NA	6.47
Minneapolis	1	1.25	4.92	1	1.90	4.39
Pittsburgh	1	NA	6.05	1	NA	5.10
San Francisco	1	NA	6.10	1	NA	3.73
New York	1	0.86	4.73	1	1.19	5.23
San Diego	1	NA	7.09	1	NA	5.47

Source: Bureau of Labor Statistics, Consumer Price Index

2. The weighting factors, as they exist in the proposed rule, are unrealistic. The escalation rates are too low. Gas, especially, would lose considerable attractiveness were a more realistic escalation rate used.

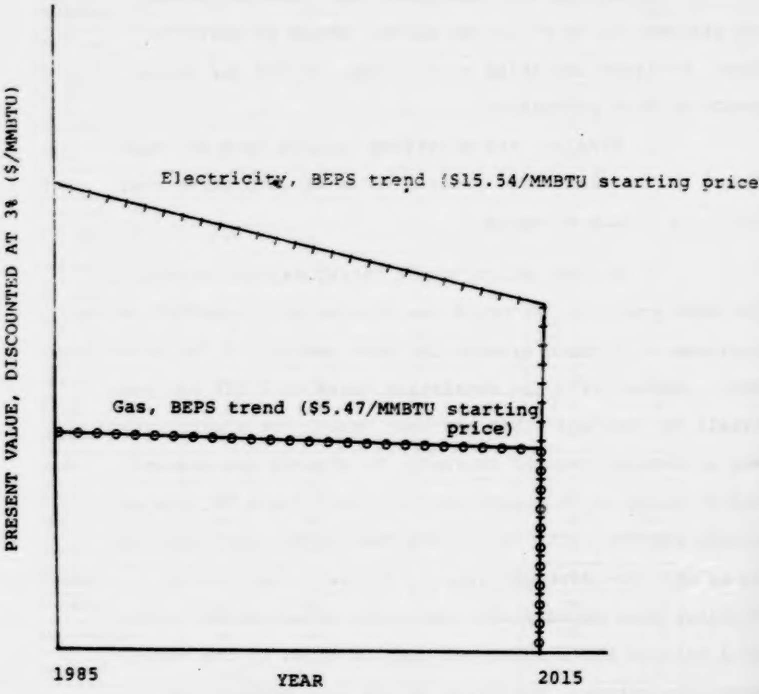
3. In the BEPS analysis, the "premium" placed on gas and oil is $7.13 per barrel, which is absurdly low. At least something on the order of $20 per barrel would be more reasonable.

4. Finally, the weighting factors have not been based on the discounted present value of fuel costs over the life of the mortgage.

To take all of these variables into account in the BEPS analysis, we would use figures of $5.45/MMBTU (which includes 1.29/MMBTU premium for gas) and $15.47 for electricity, coupled with the escalation rates of 2.81% per year (real) for gas and 1.54% per year (real) for electricity, and a discount rate of 3% real. We observe the present value curves as in Figure VIII-1. Both fuels decline in annual present value (since the real escalation rates are lower than the discount rate.) However, electricity declines more rapidly than gas. The total present value of a million BTU's saved per year is given by the area under the curves. The ratio of the area beneath the

FIGURE VIII-1

THE PRESENT VALUE OF FUELS
IN THE BEPS ANALYSIS



Source:
CECA

electricity curve to the area beneath the gas curve is roughly 2.4:1. Under DOE's assumptions, weighting factors should reflect that ratio.

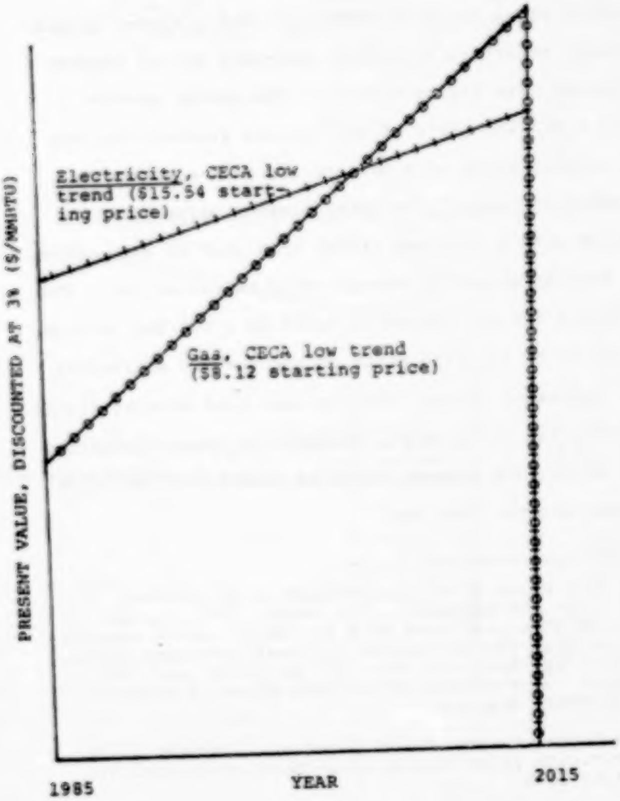
Using a $20/bbl premium on gas, which raises its initial price to $8.12/MMBTU, and CECA's higher escalation rates, we arrive at a very different set of present value curves (see Figure VIII-2). The annual present value of a million BTU's of gas becomes greater than the annual present value of a million BTU's of electricity after about 20 years. The total present value of electricity is only 1.13 times larger than that of gas. Thus, a much smaller weighting factor would be called for. The $8.12 figure for gas, which is based on a $20/bbl premium, works out to be the 1985 price of the gas BTU equivalent of oil, expressed in real 1980 dollars.2/ A similar figure for electricity would be $21.50/MMBTU.3/ Using that as an initial price, the present value of electricity would be 1.57 times greater than gas.

2/ The 1985 price of oil is arrived at as follows: $28.91 is the December, 1979 price. This is escalated at a real rate of 9.6%, which is the average of the high and low trends for real increases in the 1970's (see App. I). The 1985 price in real 1980 dollars works out to $47.14/bbl, which is roughly $8.12/MMBTU for gas.

3/ This number is derived as follows: December, 1979 electricity price equals 17.10/MMBTU escalated at 4.7% to 1985.

FIGURE VIII-2

THE PRESENT VALUE OF FUELS USING A HIGHER PREMIUM ON GAS AND CECA ESCALATION RATES



Source:

CECA

These figures are based on a 30 year period, which is the normal life of a mortgage. However, if weighting factors are to represent national priorities -- rather than the economic calculations of individuals -- then the period should be closer to 60 years, which is the normal life of a building. Using the BEPS starting prices, including premiums and escalation rates, the weight for electricity would be 2 and the weight for gas would be 1.

In fact, with a 60 year period, dropping the premium altogether and using CECA's estimates for starting price (gas = \$4.68/MMBTU, electric = \$19.34/MMBTU) and CECA's real price escalation rates (gas = 8%, electricity = 4.7%), we find that the ratio of electricity's PV to gas' PV is only 1.25:1. Thus, using a realistic set of estimates of real prices and treating housing as a national asset with a 60 year life, we find that weighting factors are largely irrelevant.

Having gone through this exercise, let us point out two fundamental difficulties with the general approach. First, the premium to be placed on gas is arbitrary. DOE set the premium at \$7.13 per barrel. Its argument, derived from the Fuel Use Act, was as follows:

> The premium was set in terms of the additional percent of life-cycle costs for coal use over those for oil and gas

> use that would trigger exemption
> from mandatory coal conversion. 4/

This is a figure intended for application in existing industrial plants, yet DOE has applied it to new residential and commercial buildings. In fact, under the Power Plant and Industrial Fuel Use Act, there appears to be no such economic exemption triggering mechanism for new plants. The number really has no relevance to the BEPS program. CECA's $20/barrel premium is no less arbitrary, but we think it is more realistic.

Even if we were to agree on a premium, this approach to weighting factors raises a second and more basic problem. If we use a weighting factor with a premium built into it, we are forcing individuals to trade one fuel which has a real price against another fuel which has an artificially inflated price. This throws the micro-economic analysis completely out of line.

The designer of a gas heated house is allowed fewer BTU's of electricity than the real prices suggest. In other words, the designer is forced to spend more for conservation than "simple" economics suggest. When home owners pay their

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4/ Weighting Factors, p. 15.

real fuel bills, they will discover that the savings are smaller than they should be. The precise impact that the premium has on the consumer is difficult to gauge in DOE's analysis because the budgets were not set at optimum points. If and when weighting factors impinge on energy designs, gas consumers will be bearing the burden of the premium. In the final analysis, it is not possible to reconcile weighting factors for fuels including premiums with micro-economic analysis done with real prices.

For all of the above reasons, we believe weighting factors should be abandoned and a new approach to the setting of energy budgets which is independent of the choice of conventional fuels should be sought.

Part Three:

LEGAL, SOCIAL AND INSTITUTIONAL ISSUES IN THE BEPS PROGRAM

CHAPTER IX

LEGAL ISSUES

A. Introduction

In this chapter we address the legal issues and problems associated with the proposed rule. There are, of course, numerous legal questions inherent in various aspects of the rule as well as in testimony both for and against the issuance of the rule in final form. It is not the purpose of this chapter to explore all such questions. Rather, this chapter is focused on DOE's interpretation of the Congressional mandate under which DOE must

> provide for the development and implementation, as soon as practicable, of performance standards for new residential and commercial buildings which are designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of non-depletable sources of energy . . .. (Emphasis added).

CECA believes that DOE's interpretation of "maximum practicable" is deficient in two respects. First, it has based its definition of practicability on considerations which are inappropriate. Second, it has failed to produce the evidence which would support this definition, even if it were appropriate.

B. Maximum Practicable Improvement

1. DOE's Conception

DOE's failure to issue sufficiently strict standards is based on sociological and economic, as opposed to technical, considerations. In the preamble, it is made clear that although it would be technically feasible to demand more in the way of energy savings, the building "community" is incapable of living up to that standard.

For example, in § 2.4.2 of the preamble, page 2-44 of the printed copy, passive solar designs are found to be "economically competitive with electrical heating in many areas of the Nation," and presumably technically practicable since there are no technical issues relating to passive solar. We are advised passive solar has "not yet achieved widespread acceptance by the design community or the building industry" and apparently is not practicable for this reason.

Further, there were decisions made to encourage passive solar, a technically feasible energy savings method, not by incorporating some form of requirement into BEPS but instead by writing a manual and hoping that the building community would use it.

In § 3.2.3 of the preamble, we find DOE concluding that

> DOE believes that a major constraint in the designs of more energy-efficient commercial and multi-family residential buildings is not technology or costs but the unfamiliarity of design professionals with energy-efficient design strategies and available technology. DOE believes that this aspect of practicability is a strong deterrent against very strict Energy Budget Levels, at this time.

And again in § 3.3.3, we are advised that there are alternatives which are "[n]ot easily achievable . . . because of the lack of information available . . . or . . . inadequate commercial availability of materials or components . . . ."

Finally, the analysis of potential energy conservation options rests on the notion that practicability includes economic limits and that those limits can best be defined by the life cycle costing technique.

It is CECA's view that the care with which DOE has presumed the existence of technical constraints as well as the use of life cycle costing and the avoidance of requirements regarding renewable energy sources (deciding to use extra-regulatory encouragement of solar) all reflect a profound misreading of DOE's mandate under the ECSNBA. For the reasons expressed below, CECA believes that because of its statutory mandate to achieve "maximum practicable" results, DOE must considerably tighten BEPS and must approach that tightening process in a different manner than it has approached the proposed rule. The discussion supporting this belief is divided into two parts: a general discussion of the agency's requirements regarding implementation of statutory goals and a specific examination of the ECSNBA.

2. Implementation of Statutory Objectives

This discussion can be brief. Agencies are clearly limited to statutory authority in rulemaking under the Administrative Procedure Act (APA) and under general principles of law. As far as the APA is involved, judicial review of agency rulemaking is governed by § 10(e)(2) of the APA, 5 U.S.C. § 706(2), which authorizes the courts to set aside any portion of regulations that is not only "arbitrary, capricious, [or] an abuse of discretion [or] otherwise not in accordance with the law . . .."

And as far as general principles of law are concerned, it is fundamental that agencies enjoy only power to effect the will of Congress and not to legislate. C.I.R. v. Clark, 202 F.2d 94 (7th Cir. 1953). In order for an agency's regulations to be valid they "must be consistent with the statute under which they are promulgated." United States v. Larionoff, 431 U.S. 864, 873 (1977); see, also, Atchison, Topeka & Santa Fe Ry. Co. v. ICC, 607 F.2d 1199, 1203 (7th Cir. 1979)("they may not exceed a statute or modify its provisions"). Accordingly, with respect to the statutory objective of "maximum practicable improvements . . ." DOE must not exceed that objective, nor must it fall short of it.

3. Alternative Conceptions of Maximum Practicable

The term "maximum practicable" is undefined in the Act (and the regulations). With one significant exception discussed below, the legislative history offers no clue as to what the term meant. Similarly, apart from the lack of any definition, the Act contains no other provision which seems to limit or define "maximum practicable." 1/

CECA believes there are two paths by which to approach "maximum practicable." One is the legislative history and the other is by analogy to similar statutory language.

a. Legislative History

Although the legislative reports are not helpful in understanding "maximum practicable," certain statements by Senator Proxmire, the floor manager of the bill, when he outlined its purposes prior to Senate debate on the legislation, are helpful. Senator Proxmire explained at one point that

> A national program is needed because present building practices in the United States inhibit the prompt adoption of energy conservation measures. 2/

1/ Under 42 U.S.C. § 6839 DOE is authorized to engage in research activities which analyze BEPS but those activities are not designed or intended to limit or explain maximum practicable.

2/ 122 Cong. Rec. 5782, 94th Cong., 2d Sess. (1976).

He stated further that the Conference Committee has

> . . . concluded that energy standards should be required for all new construction in the United States in order to assure prompt and equitable implementation of the program in all parts of the country; and to promote lower building costs through development of a national market for energy conserving materials and services. (Emphasis supplied). 3/

Nowhere challenged in the legislative record, these words can only be taken to mean that Congress intended for BEPS to alter the building practices in the national housing market. What DOE has done instead, with respect to passive solar energy (as well as other limits on BEPS), is to accept present building practices (at least as DOE defines them) as a basis for limiting the reach of its proposed standards.

3/ 122 Cong. Rec. 5783, 94th Cong. 2d. Sess. (1976).

b. Analogous Statutory Language

The term "maximum practicable" bears a kinship to language in the Clean Air and Clean Water Acts, which require the formulation of emission or pollution standards under the terms identical or similar to "maximum practicable." The language in these statutes has been often litigated and always meticulously applied by the courts. See, e.g., American Meat Institute v. EPA, 526 F.2d 442 (7th Cir. 1975); Tanners' Council of America, Inc. v. Train, 540 F.2d 1188 (4th Cir. 1976); CPC International, Inc. v. Train, 515 F.2d 1032 (8th Cir. 1975).

There is, of course, more than one kind of "practicability." In the context of ECSNBA, as with the Clean Air and Clean Water Acts, the two main senses of the term would seem to be technological and economic. 4/ Under the Clean Air and Clean Water Acts, for example, the administrator formulates national standards industry-by-industry. For this purpose, the primary meaning of the key term (practicable) is technological rather than economic. The

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4/ We do not dispute DOE's concern regarding indoor air quality, since habitability is certainly an element of practicability.

administrator must determine that the technology is not a mere theoretical possibility but actually works and is available. The mere fact that any given business may be unable to afford the technology is no objection to the standards, which, like those under ECSNBA, are national in scope and devised according to certain classifications. It is contemplated, in fact, that some concerns will be driven out of business as the price of slowly upgrading the environment. All this is spelled out with considerable care in the statute and legislative history and is now well settled by the courts.

Although we concede that the standard in the Clean Air and Clean Water Acts is not necessarily to be viewed as identical to the ECSNBA since there are dissimilarities between the purpose and regulatory scheme of the two statutes, we submit the experiences under the Acts is constructive as to the direction the courts would take.

The point is that by using technical constraints without adequate evidence and by eschewing any requirements which would insure increased use of nondepletable energy, DOE has clearly selected a weak interpretation of maximum practicable. In this connection, we should add that use of a life cycle costing yardstick may well also unduly limit maximum practicable. While economic considerations must be incorporated into a test of what is practicable, it is not necessary to choose an economic optimum when the statutory compliance goal is energy savings. We believe that a more reasonable economic guide is that presented in Chapter XIII, where we argue that BEPS is not an economic exercise. It is instead a regulatory regime supposed to achieve maximum practicable savings by setting requirements on industries and people.

With ECSNBA, Congress provided only the guidance of § 6831(b)(2) and Senator Proxmire's remarks. To whatever extent the overall similarities of the Clean Air and Clean Water Acts might be referred for collateral guidance, however, they argue in favor of a construction of "practicable" that emphasizes technology rather than the economics of individual businesses.

To the extent that sociological and economic considerations play a part in defining what is practicable, they can, at most, set the timetable for the "prompt adoption" (to use Senator Proxmire's words) of energy conservation techniques that are technically feasible.

C. The Evidentiary Basis of the Standards

Whether DOE accepts this conception of maximum practicable improvements or insists that sociological and economic considerations should play a larger role in defining practicability, adequate evidence documenting the presumed limits of practicability has not been produced by DOE. Nor, in fact, has DOE actually tried to produce such evidence. Today, the "agency must fully explicate its course of inquiry, its analysis and its reasoning. Furthermore, grounds relied upon . . . must be clearly disclosed in and sustained by the record." Tanners' Council of America, Inc. v. Train, supra, at 540 F.2d 1191. DOE never developed such grounds, however. It became so consumed with the computer modeling of the thermodynamic properties of buildings and economic optima that it conducted no research into the basic factors -- the capabilities of the design and construction industries and the availability of the materials -- upon which the standards are actually based. This is an oversight that totally violates the legal standards under the APA as explained in Tanners' Council and similar cases. As demonstrated by the court's careful review of laws analogous to the ECSNBA, the evidence required to justify a rule is substantially more than DOE's largely subjective conclusions regarding the limitations of industry to implement a stricter BEPS. See, generally, Tanners' Council of America v. Train, supra. See, also, American Meat Institute v. EPA, 526 F.2d 442 (7th Cir. 1975); and Kennecott Copper Corp. v. EPA, 462 F.2d. 846 (D.C. Cir. 1972).

Accordingly, regardless of whether DOE can defend its definition or interpretation of "maximum practicable," it has failed to develop a satisfactory basis of evidence to justify the limits it has adopted based upon its interpretation. On this ground alone, the proposed rule is legally deficient and would be set aside by the courts if made final.

D. Conclusion

All the previous chapters of this report have demonstrated the technical feasibility and economic justification for a wide variety of conservation options (superinsulation, passive and active solar energy, mechanical devices) which DOE presumably considers not "practicable" within the meaning of that term. The remainder of this comment considers non-technical, non-economic considerations which might enter into the setting of the standards. Even if these are deemed proper considerations in determining practicability, as shown later, they pose no obstacle to proceeding with aggressive energy conserving measures.

Above all, the final chapter of this part, Chapter XII, describes a methodology through which DOE ~~can~~ establish the technological, economic, sociological and institutional criteria to establish what are "maximum practicable improvements" in energy savings, including utilization of renewable energy resources, which can be achieved through BEPS. It is only by applying such a systematic methodology that DOE can fully comply with its mandate to achieve the "maximum practicable." and can develop a legally sound evidentiary basis for setting and defending the standards it issues under the ECSNBA.

CHAPTER X

ENVIRONMENTAL IMPACT

A. Introduction

A program such as BEPS which will affect the construction of all new buildings, demands that we examine potential consequences, no matter how remote the probability of occurrence, to the fullest extent possible. The Department of Energy's Environmental Impact Statement addresses a broad range of impact areas. However, DOE's analysis is very uneven -- some areas are examined with great precision and care, others are handled in a much more superficial fashion.

1. Outdoor Air Quality Impacts

DOE's discussion of the impact of BEPS on outdoor air quality is highly developed and shows clearly that the net effect of the program will be beneficial. The evidence is quite conclusive. With a BEPS program in place, less energy will be consumed and fewer pollutants will be released into the air. The stricter the standards, the greater the energy savings and the greater the reduction in air pollution.

2. Economic Impacts

DOE's analysis of economic impacts is equally clear, though the analysis is much less rigorous. Examining the data critically, we can safely conclude that neither the consumer nor the Nation will suffer undue economic harm as a result of the BEPS program. DOE has not properly examined or documented the maximum economic benefit possible, but it has demonstrated that the impact will be positive. A greater positive economic benefit will certainly result from a strict BEPS program. One issue in particular -- first costs -- should be stressed in reaching this conclusion.

a. First Costs

The building industry has declared vocally and publicly that the increased costs of buildings associated with the BEPS program will significantly reduce demand for new homes. This is a scare tactic with little basis in reality. Even assuming that conservation costs are twice as high as DOE has estimated, the cost of conservation will be less than four percent of the average total cost of new residences. The down payment necessary on this investment is less than $400. This relatively small sum is not likely to have much of an impact on demand.

Moreover, financial institutions have begun to alter lending policies so that capital costs added to a building in pursuit of lower operating costs, i.e., monthly fuel bills, do not disqualify potential home-buyers. The language of the standards and the guidelines set by the Secretary for state compliance could certainly solidify this trend. [1] Thus, financial considerations will not damage the industry and the benefits of moving the industry toward a more economically sound product will be considerable.

Above all, one must keep the issue of increased cost in perspective. The homebuilding industry is a highly cyclical industry, presently on a downward trend. From the point of view of increased ultimate costs inhibiting demand, more damage was caused to the industry by skyrocketing mortgage rates in the month of March 1980 than would be caused by BEPS -- even a very strict BEPS standard. The long-term benefits of BEPS should not be abandoned because of the short-term problems of the industry. The trend in housing starts and mortgage rates may reverse itself in short order, but a weakened or abandoned BEPS program will be difficult to revive. It is exactly this shortsightedness that neither the

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[1] The first purpose of the Energy Conservation Standards Act is written in very broad language so that decisions by the Secretary to encourage this trend are certainly within the scope and consistent with the purposes of the Act. The first purpose of the Act is to:

> "redirect FEDERAL policies and practices to assure that reasonable energy conservation features will be incorporated into new commercial and residential buildings receiving FEDERAL financial assistance."

best copy available

Nation nor the consumer can afford. [2]

3. Social Impacts

The social impacts of the BEPS program have not been adequately examined by DOE. The difficulties of

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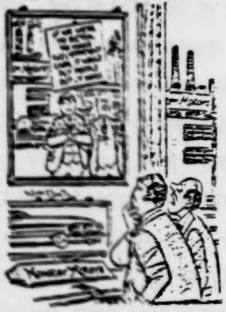
[2] The experience of the automobile industry is the most directly relevant example. After years of resisting improved energy efficiency on the grounds that it would have great economic costs, the industry discovered that the negative economic impact of not improving energy efficiency was even greater. A recent cartoon in the Washington Post (April 20, 1980) makes the point well.

"WAS THAT US JUST A FEW YEARS AGO?"



The building industry is not subject to foreign competition (since buildings are difficult to import) and, therefore, will not suffer negative economic impacts from that factor. However, the negative economic impact of building millions of inefficient houses to save a few thousand starts per year will multiply through the economy in terms of decreased purchasing power and increased energy consumption. In the long run, given the experience of the automobile industry, we suspect that more houses will be built with a strict standard than without one.

implementing the standards and the potential dislocations within the building supply and construction industries must be explored in greater detail. In Chapter XI we offer some basic approaches to implementation that should minimize its negative impacts. In Chapter XII we propose a methodology for identifying, assessing and monitoring the impact of implementation and other social/institutional practicability problems that BEPS might occasion. We believe that with this methodology in place and with a simplified, more reality-oriented approach to the program, the inconvenient social and institutional consequences can be minimized. We cannot deny the fact that there will be negative impacts resulting from the program, but the economic and strategic benefits of an aggressive BEPS program make these impacts well worth bearing.

The potential economic and strategic benefits are so great that the program must move ahead rapidly on an aggressive conservation path. We recommend that DOE carefully monitor the social and institutional impacts of such a program by shifting resources away from hypothetical computer models toward practical issues based upon reality.

4. Aesthetics and Site Specificity

DOE has gone to some length to consider the impact of the BEPS program on the aesthetics of buildings and the possible impact that site-specific characteristics, such as landscaping, wind direction, the availability of radiant heat, etc.,can have on energy use in buildings. There is some indication that site specificity will be a major focus of future research. These are important issues, but they must not be allowed to render the program more complex than need be or (more likely) to bog down the program in a multitude of details that stop it dead in its tracks. If we build sound, basically energy-efficient buildings, site-specific characteristics might change the energy performance an average of ± 30 percent. The last 30 percent of energy use, which is very difficult to model in the abstract, is of less importance than the first 70 percent, which can be easily addressed by BEPS. Technically, the bulk of energy use can and should be addressed by the BEPS program without reference to site-specific characteristics. Of course, in the standards an exemption or alternative approval process can be used for sites where specific characteristics are of overwhelming importance.

Moreover, economic considerations should not be the cause of concern about site-specific characteristics. DOE cannot possibly be concerned that a set of conservation options that is cost-justified on the windward side of a hill might not be cost-justified on the lee side of a hill. DOE has set the budgets so far from the optimum that such economic considerations are irrelevant.

In sum, site-specific impacts are a counterproductive diversion of the program from what it can reasonably be expected to accomplish.

5. Habitability Impacts

DOE's consideration of the impact of BEPS on the habitability of residences reaches a very important conclusion -- that indoor air quality is a major concern -- without fully documenting or explaining that conclusion. The importance of the conclusion for BEPS lies in the fact that it leads DOE to disallow low infiltration strategies as a conservation option with which to meet the standards. DOE's concern is that buildings with low rates of infiltration may exhibit high concentrations of pollutants which may have negative impacts on the health of the occupants.

The impact of a low infiltration building on the health and safety of its occupants needs to be studied carefully not only because DOE has eliminated this very cost-effective conservation option, but also because the building industry has been plunging ahead with a low infiltration approach to energy conservation. One repeatedly hears that builders are already exceeding BEPS, but careful examination shows they are doing so by reducing infiltration rates. If DOE's concerns are well founded, careful regulation of infiltration rates in residences through health and safety codes is necessary. If DOE's concerns are not well founded, then low infiltration rates need to be incorporated into BEPS to reduce the level of maximum energy consumption allowed.

CECA believes that indoor air quality is an issue of great importance to the consumer. Since this is a highly technical issue that requires careful scientific study, much of the subject matter must be left to the scientific community. However, we believe that the discussion of indoor air quality in the BEPS TSD's is not adequate, even from an introductory point of view. Therefore, CECA is entering into the record a basic discussion of the problems posed by indoor air quality in language that the consumer can understand. This discussion is intended to call attention to the issue -- especially since consumers are currently being sold ever tighter buildings without being alerted to the dangers -- and to provide the evidentiary basis for our recommendation that air exchangers be required in any low infiltration approach to energy conservation.

B. Indoor Air Quality

1. Institutional and Informational Gaps

a. Building Codes

Part of DOE's reluctance to adopt reduced ventilation rates as an option toward meeting the Design Energy Budgets can be attributed to the lack of information available on indoor air quality and ventilation rates (both in the residential and commercial sectors). This information is essential for establishing a base case against which to project potential impacts of BEPS on building habitability.

With over 8,000 state and local building codes in effect across the United States, it is nearly impossible to assess and generalize about the application of ventilation rates to particular building types and their uses. Because of the variability in building codes, it is not appropriate to use them as a guideline for establishing ventilation rates. Moreover, while codes are easily enforceable at the design phase and at the construction site, for the constructed building there are few accurate monitoring methods or trained officials available to determine whether ventilation rates comply with codes.

Finally, there are sc many variables that influence ventilation rates, e.g., orientation, types and sizes of windows and doors, caulking and weatherstripping, insulation, HVAC systems, as well as climatological factors, that it is difficult to generalize present construction trends upon which to establish a base case.

Where codes exist for indoor air quality, they are typically designed for occupant comfort rather than safety. These indoor air quality standards were based upon criteria reflecting current available data on epidemiological and toxicological observations noted on healthy, working individuals in the industrial environment. These results are not accurate representations of health impacts that may occur in the non-industrial indoor environment. Industrial pollutant exposure patterns differ from the commercial and residential environment in that concentrations of pollutants more frequently occur in higher concentrations over the short-term. Furthermore, that portion of the population that spends most of its time indoors -- children, the elderly and the infirm (in particular, people with cardiovascular or pulmonary disease) -- are precluded from the working environment. Data on exposures and health impacts upon these groups of people are rare; air quality standards targeted at them are almost non-existent. Thus, the purpose of and data base for existing codes is not entirely suited to the evaluation of low infiltration buildings.

b. Federal Standards

Several agencies have established air pollution standards that regulate pollutants over different averaged time periods. A significant amount of variation exists among the standards. For example, the Food and Drug Administration (FDA) has established an indoor maximum allowable ozone level of 0.05 parts per million (ppm) which is designed to protect people over extended periods of time with insufficient recovery intervals. The American Conference of Governmental Industrial Hygienists (ACGIH) and the Environmental Protection Agency (EPA), however, Environmental Protection Agency (EPA), however, have established higher maximum allowable ozone standards averaged over shorter time periods -- 0.10 ppm (8 hours) and 0.08 ppm (1 hour) respectively. These standards assume a sufficient recovery interval.[3/]

Despite these difficulties, generalizations have been established regarding ventilation rates. Single family residences, on average, have air change rates of 1.0, normally varying between 0.9 and 1.5. Multifamily and commercial structure ventilation rates are generally less; on average, 0.5 air changes per hour. This is due, in part, to the use of mechanical ventilating systems in these structures. However, the technology exists to achieve even lower infiltration rates than those stated -- with proper consideration of design and construction.

c. Information Gap

Unfortunately, information on the relationship between ventilation rates and indoor air quality is limited. The nature of the information that is available is summarized below.

1. Most air pollution studies have been conducted on outdoor air, which led to the establishment of the

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[3/] Survey of Indoor Air Quality Health Criteria and Standards (GEOMET, Inc., Gaithersburg, MD, March 1978) p. 3; Hereafter referred to as Health Criteria and Standards.

National Ambient Air Quality Standards (NAAQS) by the Environmental Protection Agency in 1971. These standards are based on health criteria which are the subject of some controversy.

2. Most indoor air quality studies have been done only on the industrial environment. Pollutant concentrations are typically higher and of shorter duration than in the nonworkplace environment. Furthermore, the health hazards observed in industrial situations were based upon and compared to ambient air standards and associated health hazards.

3. Virtually no information exists on indoor air quality in commercial structures. The concept of indoor air quality has only recently been seriously recognized and most studies have focused upon the commercial environment. The theoretical conclusions drawn from these studies are inaccurate in that there are notable differences between commercial and residential structures in terms of building design and use, number of occupants, occupant activity, pollutant sources and concentrations.

4. Work done on air quality standards in residential structures is subject to inconsistency in terms of the types of structures monitored. Many of the houses on which current research is being conducted are not prototypical of the houses that will be constructed under BEPS. Other variables will determine the outcome of research efforts after BEPS: changes in

building materials, structure size and orientation, changes in HVAC equipment installed, as well as types of monitoring equipment used and methods of experimentation and analysis. The lack of testing standardization must certainly not be overlooked.

5. There is insufficient information on the nature of air pollutants themselves. While it is generally well understood how and from where pollutants are generated, little is understood about how particular pollutants may interact with one another at different concentrations.

As one recent study concluded: "There has been no scientific effort to establish air pollution standards specifically for the indoor, nonworkplace environment." [4] What studies have been done have been conducted under controlled environments that do not reflect actual indoor conditions. Any standards developed for the indoor environment must consider its particular character. 1) Exposure to pollutants is usually continuous and over an extended period of time. 2) Pollutant concentrations, e.g., particulate, CO, SO_2 emissions from gas stoves, are very dependent upon occupant behavior and may periodically peak above ambient (outdoor) levels. On the other hand, building envelopes effectively serve to shield occupants from high outdoor levels.

4/ Health Criteria and Standards, p.4.

Thus, the information gap results from the complexity of the interaction between biology, chemistry and the physics of buildings.[5]

But even the question of indoor pollution concentrations alone is a complex one. Indoor air pollution is affected by a number of variables: 1) building materials used in construction; 2) building site; 3) occupants' activities (smoking, cooking, cleaning, human odors); 4) HVAC equipment; 5) original levels of indoor pollutants; 6) rate of penetration from outdoors; 7) emission rates from internal pollutant sources (i.e. radon emissions from building materials) and ventilation rates.

The severity of health impacts will depend upon the pollution sources present, their original concentrations in both the indoor and outdoor environment and exposure time to the contaminants. Exposure to toxic substances over a prolonged period may be more detrimental than brief exposure to higher concentrations of relatively unreactive pollutants. Appendix III gives a brief summary of the potential impact of the pollutants which are of health concern in residences.

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[5] C.D. Hollowell, J.V. Berk, C. Lin, W.W. Nazaroff, G.W. Traynor, "Impact of Energy Conservation in Buildings on Health" (Lawrence Berkeley Laboratory, Berkeley, CA, June 1979) p.2; Hereafter referred to as IECBH.

It is crucial that means be developed to compare indoor and outdoor pollutant levels and health impacts on a meaningful basis.

C. Conclusion

In the final analysis DOE chose not to give credit for reduced ventilation rates as a conservation strategy. Several reasons were given for its decision:

1. In commercial buildings, ventilation reductions were found to provide a potential for code violation.

2. In residential buildings, habitability would be adversely affected to a significant degree. [6]

3. Ventilation reductions were determined to affect adversely fire and smoke behavior in buildings.

CECA shares DOE's concern about infiltration rates, but rather than exclude reduced infiltration as a conservation option, we believe that it can be permitted safely by requiring controlled air change, i.e., by requiring heat and air exchangers There are a number of reasons why we reach this conclusion.

1. To dismiss a conservation strategy as important as ventilation rate reductions based on a few code violations in

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[6] Draft Environmental Impact Statement (Department of Energy, Washington, D.C., November 1979) p. 4-43; Hereafter referred to as DEIS/DOE.

the redesign phase is unfounded. DOE does not indicate anywhere what codes were violated, in what respect and to what extent the violation occurred. This makes it difficult to assess accurately whether its claim is justifiable. Moreover, controlled air change should be credited in health codes.

2. Adequate habitability refers to the appropriate level of humidity that greatly diminishes or eliminates the concern of adverse health impacts. DOE maintains that "reductions in ventilation rates would result in increased concentrations of continuously generated pollutants and longer exposure to intermittently generated pollutants."[7] Again, the validity of this statement can only be assessed in light of carefully defined parameters, i.e., occupant behavior, the building materials used, air leakage rates and, especially, the concentrations of pollutants present before decreases in ventilation rates occurred.

Some generalizations can be made about the projected changes in pollutant concentrations from reduced ventilation rates. The greatest danger is presented by inert substances such as carbon monoxide, particulates and carbon dioxide, which are generated indoors and infiltrate from outdoors. Reduced ventilation rates will increase contamination concentrations of these substances and decrease indoor air quality. Reduced ventilation rates will not have much impact upon indoor air quality in the presence of reactive pollutants. Whether generated indoors or outdoors, these pollutants dissipate quickly and will generally persist only for short durations at elevated concentrations. The cumulative effects upon health of repeated exposure to high, short-term concentrations is a topic under investigation.

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[7] DEIS/DOE, p. 4-43.

In calculating the Design Energy Consumption for residential buildings, a multiple regression equation was used to determine an average ventilation rate based on observations of wind speed and temperature differences taken around the country. The resulting air change rate was 0.6 for an average winter day.[8]

The 0.6 air change rate is quite a bit below the average residential rate of 0.8-1.0 per hour measured in many residential structures constructed before the mid-1970's. Since the 1973 oil embargo, however, houses have consistently utilized lower ventilation rates. The 0.6 rate is also in general agreement with the result of extensive research which recommends 0.5

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[8] Economic Analysis, p. A-17.

air changes per hour as the desirable rate for residences.[9] This rate is merely a guideline to be used to help ensure that concentrations of indoor pollutants do not exceed ambient levels.

According to a recent study, "The desirable air exchange rate has been determined by considering changes in the magnitude of the pollutant concentrations and not in the resulting health effects." [10]

This rate does not imply that lower ventilation rates should not be encouraged. The technology is available to mitigate drastic changes in indoor air quality. Sweden and Denmark, in fact, have adopted very strict ventilation standards. Denmark has set a natural ventilation rate of 0.3 as an energy conservation measure. Sweden's residential ventilation rates are typically 0.25 air changes per hour. "To overcome the health hazards associated with such low rates, mechanical ventilation, coupled with heat exchangers, can provide for sufficient fresh air without excessive heat loss." [11]

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[9] Demetrios J. Moschandreas, Ph.D., "Indoor Air Pollution in the Residential Environment - Executive Summary" (GEOMET, Inc., Gaithersburg, MD, August 1978) p.8; Hereafter referred to as "Indoor Air Pollution." See also:
"Energy Efficient Buildings Program" (Lawrence Berkeley Laboratory, Berkeley, CA, August 1978) p.2; Hereafter referred to as LBL Annual Report.

[10] "Indoor Air Pollution," p.8.

[11] LBL Annual Report, p. 2.

These conservation measures are widely incorporated into European residences at present, but generally are not available on the U.S. market.

D. Recommendations

The most important thing to keep in mind is that BEPS are intended to be performance standards and should be implemented as such with stringent provisions that ensure conservation. The preclusion of ventilation rate reductions as a conservation strategy reflects DOE's overly cautious approach to the practicability issue. DOE has expressed a proper concern for the public health impacts of reduced indoor air quality that might result from low infiltration rates. However, DOE has discounted too easily a very simple, cost-effective solution to the problem of indoor air quality. CECA believes that low infiltration approaches, coupled with heat and air exchangers, should be allowed as energy conservation options to meet a strict BEPS standard.

The problem of the current availability of these mechanical devices would be quickly overcome were DOE to declare the acceptability of low infiltration strategies that utilize air exchangers. This approach could save the nation too much energy and the consumer too much money to be disregarded. CECA believes that a healthy indoor environment and energy conservation goals need not be mutually exclusive. The technologies (embodied in air exchangers) to mitigate adverse effects are effective and feasible. A standard that encourages strategies (appropriately suited to building size,use, occupancy and location), which maximize ventilation reductions without jeopardizing public health as a result of increased indoor air pollution or fire and smoke risks,is supported by CECA and should be embraced by DOE.

This recommendation, added to the conclusions reached earlier in the discussion of other potential impacts, suggests that an aggressive BEPS program is called for. Outdoor air quality will improve as a result of an aggressive BEPS program and the problem of indoor air quality is easily manageable. There will certainly be a positive economic result from the program which will far outweigh any negative social or institutional impacts. Thus, from the point of view of the potential impacts of the program, there is every reason to move vigorously ahead.

CHAPTER XI

IMPLEMENTATION

A. The Importance and Difficulty of Implementation

The success or failure of BEPS will be determined in large part during implementation. BEPS is a complex regulation, governing a relatively new field of energy use in buildings. DOE hopes to enforce the regulations through existing construction control mechanisms. Unless the building industry is willing and able to comply with BEPS and unless building code authorities are able to enforce the regulations, a great deal of federal effort and funds -- and a potentially vital national energy policy -- will have been wasted. As important as implementation of the standards is, it poses a number of significant difficulties.

1. Equivalence

The performance standards themselves establish design energy budgets for various kinds of buildings which states must incorporate (in some equivalent form) into their building codes. DOE's implementation plan must consider exactly what is "equivalent" to BEPS -- whether, for example, a state's component-performance standards will produce the same results for a given building design as BEPS. DOE must guide states in translating BEPS, which involve complex analyses of building designs, into codes which will be imposed on a construction industry that produces most of its buildings without the expertise of professional designers (architects and engineers). And code enforcement staffs, which are often small operations lacking technical expertise, must be able to evaluate whether designs comply with the standards.

2. Personnel

In developing an implementation plan, DOE can use at least three strategies.

a. First, DOE can give states the funds to hire professional designers for their enforcement staffs to help enforce BEPS and to provide training to non-professional members of enforcement staffs and the building industry. Still, major changes in understanding do not come easily.

b. Second, DOE could simplify the regulations to the point where the need for extensive training and upgraded enforcement capabilities would be minimized. This strategy, however, might mean abandoning the fundamental approach which Congress chose to apply to energy conservation in buildings -- regulating the energy performance of buildings rather than prescribing particular components which builders must use.

c. Finally, DOE could encourage professional designers to certify that building designs are in compliance with BEPS. This would mean that every building would require the services of a designer, when designers would not necessarily have been involved otherwise. Moreover, enforcement staffs would become totally dependent upon the cooperation of the design profession.

3. Prescriptive Versus Performance Approaches

The basic implementation strategy proposed in the November 1979 NOPR allows the vast majority of building designs to sidestep the performance standard entirely by following an "equivalent" component-performance standard instead. This would seemingly be in conflict with DOE's congressional mandate. Solar energy and other renewables may be the losers here, since DOE has placed itself in a position where it can promote design components only if it prescribes them. That is, unless a simplified component approach to solar energy is developed, individuals who choose to meet BEPS with solar strategies will have to go the performance route. This places solar at a disadvantage vis-a-vis the conventional conservation techniques which have been boiled down into simple prescriptive codes. DOE proposes no strategy in the NOPR for encouraging renewables in the absence of a performance standard and this results in the direct discouragement of renewables. CECA believes that unless renewables are aggressively and affirmatively promoted, DOE will be in direct violation of its congressional mandate.

DOE has divided buildings into two categories with separate implementation strategies. Smaller, less complex structures would have the option of using a simple prescriptive code. But large buildings, over 50,000 gross square feet, would have to be "evaluated and certified by a qualified design professional using an approved evaluation technique," i.e., they would have to use the performance approach. 1/ The different approaches for these two building classifications raise separate issues.

4. Separating the Standards from Implementation

Although DOE intends to release a separate NOPR detailing its implementation plan, the November 1979 NOPR proposed a basic implementation framework which, absent serious opposition, DOE seems likely to adopt. Implementation raises crucial issues regarding the standards themselves. DOE's forthcoming implementation plan will contain simplified alternatives to the proposed regulations. These alternatives will probably be used far more frequently than the actual performance standards. CECA finds it exceedingly troublesome to comment on the first installment of BEPS when the implementation plan in the second installment may create a dramatically different regulation, scaled

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1/ Notice of Proposed Rulemaking, Federal Register, Nov. 28, 1979, p. 68158.

down in response to the obstacles to implementation. CECA will follow the course of the implementation regulations carefully. In this chapter, we offer some observations about the fundamental principles by which the implementation strategy should be organized.

B. Small Buildings

Ninety percent of the nation's new buildings are single-family residences or other small structures. 2/ The vast majority are built without the supervision of a professional designer because their designs are simple and familiar to builders. As a result, code enforcement capabilities are geared to the expectation that 90 percent of the buildings will have simple designs. Because BEPS may add complexity to these simple designs, the greatest challenge to BEPS implementation lies in reconciling the complexity of BEPS with the simplicity of most building designs.

1. Performance Versus Prescriptive Standards

To meet this challenge DOE has allowed small buildings the option of meeting either a performance or

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2/ U.S. Bureau of the Census, 1978 estimates.

a simpler prescriptive standard. Given such a choice, there is compelling evidence that the vast majority of applicants for building permits will opt for the conventional prescriptive approach. According to a March 1979 survey of building code authorities in states whose codes allow such a choice, less than two percent of the applicants in the 18 applicable states utilized a performance approach. 3/ Although the survey admits some imprecision, the point is made that if a simple prescriptive option exists, most permit applicants will choose it. It is more familiar to -- and, at first glance, cheaper for -- a builder to follow the conventional prescriptive building code than to calculate design energy consumption. Thus, one must conclude that under DOE's proposal most buildings will not be designed using the BEPS performance approach.

Although a performance standard might be difficult to implement, it has benefits which must be identified and incorporated into a prescriptive alternative, as we propose in the following section. The most obvious benefit is flexibility, since designers are told not how to design, but what overall energy goal they must meet. Prescriptive

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3/ National Conference of States on Building Codes and Standards, "Survey on Utilization of Systems Analysis (Performance-Based) Designs in State Energy Conservation Codes," March 1979.

codes are so confining as to discourage innovation; a performance standard,on the other hand, would at least allow such innovation. Above all, the encouragement of widespread use of renewable sources of energy will be greatly inhibited if DOE permits the standards to degenerate into traditional prescriptive component codes. Under DOE's approach, renewables, especially solar, will have to be considered only through the performance alternative. Therefore, most builders will opt for the simpler, less costly prescriptive approach. To counter this tendency, DOE must produce a standard which makes buildings that utilize renewable sources of energy at least as easy to have certified in compliance with BEPS as buildings which use only conventional approaches to energy conservation.

2. Prescriptive / Performance Hybrid

Given the implementation-related advantages of a prescriptive standard, it is desirable to seek a middle ground between performance and prescriptive standards for small buildings. Below we propose a hybrid standard which would retain the primary benefits of a performance approach, especially the affirmative encouragement of solar energy, without imposing unrealistic complexity.

As discussed in other chapters of this report, CECA believes that the standards should be set at the level of the BEPS strict case, 30 percent more stringent than proposed. Nominal BEPS, in prescriptive terms, could be used as a base level of conservation, to which additional conservation would have to be applied to decrease energy use by 30 percent. The twin goals of flexibility and encouragement of renewables (which are clearly related) could be achieved by providing a broad selection of conservation measures, any of which could be chosen to upgrade the nominal BEPS requirements to 30 percent greater conservation levels.

The pool of conservation options would include heavy insulation, optimum passive solar, minimum infiltration and active solar. These four options could be prescribed in the building code as packages, any of which would reduce nonrenewable energy use by 30 percent. The prescriptive code could also contain a pre-calculated table of tradeoffs among these four options, such that varying combinations of the options could be employed to achieve the same 30 percent reduction in energy use below nominal BEPS.

The Florida State Building Code provides a useful lesson in combining the flexibility of a performance approach with the simplicity of a prescriptive standard. 4/

4/ Florida Model Energy Efficiency Code for Building Construction, Section 9.

The Florida code's Section 9 is a performance standard which utilizes a simple four page worksheet. Energy use variables are identified on the worksheet and various tables are provided which dramatically simplify the calculations -- to the point where only basic arithmetic is necessary.

The Florida code uses a point system as an index of energy use. A certain number of points is assigned to each energy-consuming feature. For residential buildings, if the total points, divided by gross floor area, are 100 or less, the design complies. According to the Florida Energy Office, a house with 70 points will use 30 percent less energy than a 100-point house. 5/ This means that diverse energy-saving measures can be compared and combined, point by point, to achieve a 30 percent reduction in design energy consumption.

Using the Florida concept, DOE could ascribe "points" for the range of design options which we have already identified, i.e., heavy insulation, passive solar, low infiltration and active solar, to be used to reduce design

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5/ Florida State Energy Office, "Instructional Materials for the 1979 Building Officials Seminars on the Implementation of Florida Model Energy Efficiency Code for Building Construction, Section 9," November 14, 1979, pp.5-6.

energy consumption to 30 percent below nominal BEPS. Such a point system would allow builders to select among a large assortment of design options without facing the complexity of calculating how much energy a given option would save. A builder could select one of these four options and incorporate it entirely for a 30 percent reduction in design energy consumption or could choose certain portions from each package, adding together the points to achieve a total 30 percent reduction.

It is especially important that the problems posed by the complexity of BEPS not hinder those who contemplate the use of renewable energy sources in their designs. Manual calculations of the contribution of solar -- heat gain/loss factor, heat storage capacity, shading coefficients -- can be simplified through precalculated tables and a special solar worksheet.

CECA believes that computer analysis simply has no place in the calculation of design energy consumption for small buildings. Heat loss, heat gain and internal load factors are straightforward calculations and do not warrant such complexity. It is quite feasible, as the Florida building code's Section 9 has shown, to calculate design energy consumption using a simple worksheet. Such a simple manual calculation technique is essential if design energy consumption calculations are to be at all comprehensible to the builders, drafters and plan reviewers who currently handle simple designs.

C. Large Buildings

DOE has determined that the design of certain buildings is so complex that a simple prescriptive code cannot be used to regulate energy consumption. For large buildings DOE has indicated that the interaction of design energy features makes it difficult to regulate buildings based on their components. The building components may perform differently in combination than they do alone. There are two primary questions associated with DOE's decision to require a performance calculation for certain designs. First, how should DOE decide which buildings will benefit most from a performance requirement? Second, how will code enforcement staffs enforce regulations which introduce complex calculations and computer analysis?

1. Performance Versus Hybrid Prescriptive Standards

If we assume that flexibility and the encouragement of renewables can be accomplished through a hybrid prescriptive code like that suggested above, the benefits of a performance approach for large or complex designs are reduced to two factors.

a. In large buildings, where energy costs are likely to be the greatest, a performance calculation facilitates a cost-benefit analysis among various energy-saving design options to compare their life cycle costs. Here the expense of a comprehensive energy analysis is most likely to pay off in terms of energy savings.

b. A more complex consideration is whether a design's energy use dynamics offer so many variables that a prescriptive code simply cannot regulate them all. If most of a design's energy use is related to a central HVAC system and most energy loss is through the thermal envelope, a prescriptive standard would be an accurate tool for regulating energy use. On the other hand, if much of the space conditioning energy use is determined by process heat (internal load), then a performance approach is more appropriate.

DOE has selected two factors to use in deciding which buildings must use a performance approach. The first is design complexity as we have described it above. The second is whether a design professional is already involved in the design process. DOE does not want to mandate a complex performance calculation which will require the expertise of a professional designer unless a designer is already involved in the design process of a given building.

Many states already require that above a certain building size or for certain classifications of buildings a licensed design professional must be involved in the design process. This requirement is based primarily on concerns for public safety, with the professional's attention being directed for the most part to structural integrity and fire safety in the design. As a rule of thumb, the only buildings for which states consistently do not require a licensed designer are single-family residences and other one or two story buildings used for private purposes.

In order to identify designs which involve both factors -- complexity and professional designers -- DOE has introduced gross floor area as the basis for imposing a performance calculation. By setting the cutoff point at 50,000 square feet, DOE is seeking a level of floor area above which a "safe" majority of designs meet both conditions for imposing the performance requirement. The problem with this approach is that it will allow smaller buildings to use a prescriptive approach regardless of whether the complexity of their design features may merit a performance requirement.

North Carolina, which requires a performance calculation in its building code, has set the cutoff point at 15,000 square feet -- 70 percent below DOE. 6/ In choosing

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6/ North Carolina State Building Code, Section 3202.9

50,000 square feet DOE has probably found a building size above which virtually all buildings will meet the conditions for a performance requirement. This methodology, however, is sorely lacking in precision.

CECA recognizes that the use of gross floor area here is probably the most practical method of imposing the performance calculation. And DOE is correct to set the cutoff point conservatively high to minimize exceptions to the requirement. However, the primary test continues to be the complex question of whether the building's energy use is oriented to the HVAC system and thermal envelope.

CECA believes this question is best left to the judgment of the design professional. Since most states require designer supervision in larger or taller buildings, we propose that in designs under 50,000 square feet, any designer supervising the design process must make a finding as to whether design complexity merits a performance approach. If the designer determines that the building's energy use is not primarily oriented to HVAC and the thermal envelope, then the designer would have to use a performance calculation in order to comply with the building code.

DOE is reasonable in suggesting that 50,000 square feet is a fair size at which a building will likely require a performance calculation. Below such a cutoff point, however, DOE should leave to the states or individual builders the decision as to when a builder should employ a design professional. However, once that professional designer has been hired to supervise the design process, he/she must certify whether a performance calculation is necessary.

D. Enforcement and Liability

DOE has recognized that code officials will not be able to enforce BEPS if they must check the design energy consumption calculations for every complex building design. But plan reviewers already face this problem with other complex portions of building codes (such as the calculations associated with structural features) and they have learned to overcome it.

In current practice, a building code official may receive a complex design which is "certified" by a licensed designer. Usually this means that the designer has signed a statement that, "to the best of my ability," the design has been prepared in compliance with the local code. A plan reviewer may spot check a design or may accept the certification without question -- especially when a reputable designer's work is under consideration. It is not clear whether this "best of my ability" statement constitutes "certification" as intended by DOE in the NOPR.

In smaller cities, under 100,000 for example, the code enforcement staff frequently does not have the resources to review complex designs for compliance. In this instance, the few complex designs that are submitted may either be accepted based upon the designer certification or forwarded to a larger code enforcement office for review. There is some incentive for builders of commercial structures to use reputable designers, since costly delay in obtaining a building permit may thereby be avoided.

The primary questions in the use of a complex performance calculation revolve around designer certification: 1) Will designers accept the responsibility for certifying compliance with BEPS? and 2) Is the liability imposed by the certification statement adequate to protect building consumers from negligent design errors?

The organized design profession has never claimed that it is unwilling or technically incapable of calculating design energy consumption for complex designs. Reticence in the profession has arisen from DOE's use of the term "certify," which is not necessarily equivalent to the "best of my ability" statement which is currently in common use. If designers can guarantee compliance with BEPS in the same fashion they already guarantee compliance with other building code provisions, there is no apparent reason for the design profession to view this new responsibility of assuring BEPS compliance as anything but a stroke of good fortune.

Questions have been raised concerning who is liable if a building exceeds its estimated design energy consumption once it is built and operating. The important factor in this regard is the statement which designers sign to certify their work. If a licensed designer guarantees that "to the best of my ability" a design complies with the building code, will that statement protect building owners from incompetence or negligent errors by designers?

CECA believes that this certification statement offers adequate protection to building owners. As licensed professionals, designers' required capabilities are explicitly defined in the licensing process. Designers would clearly be liable if their certified designs did not comply with BEPS, just as contracting builders would be liable if construction did not conform to the design.

The liability issue is a problem only if architects and engineers must certify operating performance. BEPS do not relate to actual operating performance. However, states may write their building codes differently. CECA believes that the issue of how states draw up codes to incorporate innovative approaches to energy use regulation should be studied further in DOE's implementation plan and carefully considered during certification of state codes.

If the liability issue is an issue at all, it is one of professional competence, not ill-defined or unreasonable liability. If some design professionals, who stand to gain considerably from these certifications, are unsure of their ability to perform these calculations accurately, the threat of liability should encourage them to refresh their training in this area. From all indications, the design profession has the basic skills to perform the calculations.

E. Recommendations

CECA believes that a great deal of work remains to be done with regard to implementation. We recommend that DOE simplify its approach and produce a prescriptive/performance hybrid which will be easily comprehensible to the average builder and building inspector. The vast majority of residences are constructed by builders who erect a small number of units each year without the services of design professionals. This diverse audience is the one with which DOE must communicate if the BEPS program is to succeed. We believe that a great deal of the opposition which is presently voiced by builders to BEPS would dissipate if DOE were to issue a simple, understandable standard.

For more complex buildings, DOE should rely on states to determine which buildings require the performance approach. There are existing building code practices which could easily be modified to accommodate BEPS.

Above all, in considering alternative approaches to BEPS, DOE must move away from its reliance on computer based models. These models have produced standards that are far too complex for the building community to utilize or for the states to enforce. DOE should redirect its attention toward learning about the communities and individuals who will have to make the program work, so that an effective implementation plan can be created.

CHAPTER XII

A METHODOLOGY FOR ASSESSING PRACTICABILITY

A. Introduction

In Chapter IX, we have examined in detail the legal concept of "maximum practicable improvement." The basic conclusions reached are that "maximum practicable" means something a good deal stricter than "common practice" and that BEPS, as DOE has formulated them, have not come close to achieving what is maximally practicable. Put another way, DOE has not documented the reasons why, in this instance, it considers maximum practicable improvement to be almost identical to common practice.

Let there be no mistake about it: The issue of practicability looms large in the BEPS analysis. Technical and economic considerations have not set the levels of energy conservation that are targeted by BEPS. Considerations of practicability have. DOE has precluded low infiltration as part of the standards pending availability of air exchangers, which would answer environmental questions. It has precluded high levels of insulation because they are not in common use and there is some question about construction techniques and availability of materials. It has set the commercial energy budgets extremely far from the economic optimum because "DOE believes that a major constraint in the design of more energy-efficient commercial and multi-family residential buildings is not technology or costs but the unfamilarity of design professionals with energy-efficient design strategies and available technology." 1/

At one point, a number of federal experts were asked to comment on the practicability of the standards, after they had been set. This assessment of practicability made no attempt to survey the groups most affected by BEPS; was unsystematic in choosing the federal experts; generated an incomplete set of data; and failed to analyze even that data thoroughly. If practicability is going to be allowed to play such a critical role in setting a limit to conservation, then a much more systematic approach to the assessment of practicability will have to be undertaken.

Since the law mandates "maximum practicable improvement in energy efficiency and increases in the use of nondepletable energy sources," each time a problem of practicability is raised as an obstacle to greater efficiency or increase in use of nondepletables, it needs to be fully documented. We should assume that the maximum can be done until it is proven impracticable.

1/ NOPR, p. 3-4

Furthermore, a careful and complete study of practicability would provide an indispensable assessment of obstacles to greater conservation in the housing and commercial buildings sector, within and beyond the BEPS program. This would define those areas which DOE should monitor for developments that could change the limits of practicability. It would also provide information to industry and other interested groups about where to apply their efforts to improve energy efficiency in buildings.

Since the BEPS analysis contains almost no serious consideration of practicability, criticism of its methodology will not go very far in solving the problem. Therefore, this section proposes a methodology for assessing practicability *de novo*. The methodology is an adaptation of a general approach to analysis of social programs developed by the Urban Institute under contract to the Department of Health, Education and Welfare. 2/ This methodology, though intended for somewhat different purposes, is easily adapted and ideally suited for the task at hand. According to the Urban Institute:

> In our research over the last five years, we have defined a number of conditions which, if present, generally disable attempts to evaluate performance. More fundamentally, though, these

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2/ Richard E. Schmidt, John W. Scanlon, James B. Bell, *Evaluability Assessment: Making Public Programs Work Better* (Washington D.C., The Urban Institute, 1978).

> conditions also disable attempts to manage programs for important results of national concern. Having identified what we believe to be roadblocks, we then set out to develop methods to eliminate these roadblocks. 3/

Instead of targeting as the object of the analysis "roadblocks, which disable attempts to manage and execute programs," we focus on problems of practicability, which inhibit conservation in the building sector. With that shift of emphasis, the methodology has a number of features which make it especially effective for a study of practicability.

1. It is structured to involve the diverse groups that are involved in the actual activities being studied.
2. It generates complete accounts of the activities and problems under study.
3. It forces alternative accounts to be reconciled with one another.
4. It provides a logical framework for assessing the points of greatest difficulty in arriving at an effective execution of activities.
5. It defines alternative solutions to those difficulties.

B. The Practicability Assessment

The methodology for assessing practicability involves an iterative process in which descriptions of

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3/ Evaluability Assessment, p. 3.

best copy available

specific problems of practicability are developed and refined. The steps in the process are as follows:

1. Identify Practicability Problems
2. Collect Documentary Materials
3. Prepare Basic Model
4. Identify and Interview Key Actors
5. Assess Descriptive Accounts
6. Reconcile Accounts and Prepare Final Model
7. Prepare Alternative Options and Record Actor's Responses to Options

For each step there are a number of carefully defined procedures and instruments which are intended to create a systematic basis for arriving at qualitative judgments about practicability. A brief description of the procedures, tailored to the study of practicability, follows:

1. Identifying Practicability Problems

Since the publication of the ANOPR, the Department of Energy has heard a large number of opinions about the practical problems with the BEPS program. These can be sorted to create a list of fundamental issues that need to be explored. In developing the list, it is important to organize issues into categories that will make sense to the actors involved. The categories that DOE has used in the TSD's -- social, economic, environmental, institutional -- are probably not the best for purposes of eliciting comment by members of the building industry or other groups affected by BEPS. It would be better to organize the issues into functional areas that occur in the building process, e.g., materials, design, finance, construction, implementation (see Table XII-1).

The organizing framework should not be overly specific. To avoid simply generating a long list of small issues that cannot be coherently analyzed, categories should be broad enough to allow some generalizations about the nature of problems and potential solutions.

2. Collecting Documentary Materials

Before field work begins, a thorough and systematic review of the literature must be conducted. This will improve the conceptualization of problem areas and allow the research to focus on the specific issues that have been previously identified as significant. A preliminary list of potential sources should include the following:

a. Legislation
b. Hearing Records
c. Regulations
d. Federal Program Reports
e. State and Local Program Reports
f. Research Reports
g. International Comparisons

The literature reviews conducted by DOE have been quite unsystematic and incomplete. Of special importance would be reviews of actual program experiences at the federal, state and local levels. For several years now, DOE has treated BEPS as a theoretical exercise and only at the last moment did it realize that there were significant lessons to be learned from the years of experience that had been gained

TABLE XII - 1

IDENTIFYING PRACTICABILITY PROBLEMS
(General Areas)

A. Materials

1. Availability
2. Performance
3. Habitability impact
4. Environmental impact
5. Liability

B. Design

1. Design profession adaptability
2. Registration
3. Licensing
4. Liability

C. Finance

1. Impact of first cost
2. Lending policies

D. Construction

1. Adaptability of construction techniques
2. Cost
3. Habitability
4. Demand for labor
5. Registration
6. Licensing
7. Liability

E. Implementation

1. Choice of administrative vehicle
2. Definition of administrative process
3. Enforcement mechanism
4. Funding

Source:

CECA

in a variety of building sector energy programs.

In this area, international experiences are of extreme importance. The DOE research has completely neglected these cross-national comparisons, to the detriment of the BEPS program. There are a number of nations at similar levels of economic development to the U.S., with similar or more severe climates, that have been grappling with the problem of energy use in buildings for some time. While a study of these experiences cannot be interpreted as defining exactly what can or should be done, they can provide important insights as to the best path to follow.

If international comparisons serve an important purpose in establishing patterns of possible change in the buildings sector, historical comparisons can serve an even greater purpose. Every area of the buildings sector that has been identified as a potential problem from the point of view of the practicability of mandating future changes has probably undergone a significant change in the last half century. Case studies which focus on these recent historical events will go a long way toward defining the pattern that change follows and how quickly it takes place.

3. Preparing Basic Models

On the basis of the original definition of issues and the literature review, a basic description of specific problem areas should be developed. These descriptions entail three parts (see Table XII-2). The first part lists all of the events in a potentially problematic sequence, defining each event, stating how it can be measured and working out all the logical connections between events. The second part states the satisfactory and unsatisfactory conditions that might arise in the sequence, both for specific events and the timing of events. Finally, careful attention should be paid to measurement -- to defining the characteristics to be measured carefully and developing specific, reliable instruments for measuring them.

The development of this basic model, including careful attention to measurement, will enable the research to "challenge" (on paper at least) accounts of problem areas put forward by the individuals surveyed which are factually incorrect. It also creates the basis for monitoring developments in those areas where problems do exist.

4. Identifying and Interviewing Key Actors

With the basic models prepared, focused interviews with the relevant individuals can be conducted. We have identified 11 categories of actors who would seem to be of special relevance to the BEPS program (see Table XII-3). We believe it would also be useful to identify two types of actors within each category -- traditionalists and innovators. This would provide a tool for evaluating the accounts of

TABLE XII - 2

PREPARING BASIC MODEL

A. Describe Event Sequence

1. List all events
2. Define events
3. State measurement of events
4. Organize all logical implications

B. Satisfactory and Unsatisfactory Conditions

5. State satisfactory and unsatisfactory outcome or level of an event.
6. State satisfactory and unsatisfactory time frames.

B. Measurement

1. Characteristic
2. Specific measure
3. Instrument for measurement
4. Operation of measurement
5. Estimate of error

Source:

CECA

TABLE XII - 3

IDENTIFYING KEY ACTORS

Categories of Actors	Types of Actors	
	Traditional	Innovative
Manufacturers		
Design Professionals		
Construction Professionals		
Lending Institutions		
Real Estate Industry		
Assessors		
Labor		
Consumers		
Federal Officials		
State Officials		
Local Officials		

Source:

CECA

problems which they provide and would also ensure that different segments of each community are heard from. If one leaves it to chance or relies on existing institutions to provide data (as has been done by DOE), one tends to exclude the more innovative segments of the community.

If a systematic and meaningful data base is to be generated, the interviews with the relevant actors should be focused around the basic models and must be as complete as possible. This should include an effort to have the respondents detail possible solutions to the problem.

5. Assessing the Descriptions

Since the descriptions of potential problem areas will be largely subjective, a framework for assessing each account must be systematically applied. A preliminary framework is provided in Table XII-4. It is intended to assess the internal coherence and factual quality of the account, independent of other accounts. Each event and event sequence should be examined for the completeness and reliability of definitions used and the validity of the representation of events. In addition, the plausibility of the argument and its acceptability to the program should be assessed. If the factors which the respondent cites as the cause of a problem do not seem capable of actually creating the problem, the account should

TABLE XII - 4

ASSESSING DESCRIPTIONS

	Event		
	1	2	3
Well defined (identify measures and gaps)			
Reliability (independent, repeatable measures)			
Valid representation (fits with prior research)			
Plausibility (adequacy of account to produce outcome)			
Acceptability (expectations are acceptable to program)			
Feasibility of Solution (available infomation, cost)			

Source:

CECA

be questioned. Similarly, if the expectations of the actor violate the intention of the program, i.e., "you can't do it, because you shouldn't be trying to," the account should be questioned.

6. Reconciling Accounts and Preparing the Final Model

After assessing the accounts, they are combined to produce a final model (see Table XII-5). Areas where there is complete agreement on the nature of the problem go directly into the model. Areas where there is disagreement will require a decision on the part of the researcher. As part of this decision process, the assessment of the accounts will play an important role. Those accounts which have been assessed as "better" should carry more weight. Areas where more information is needed should also be identified, along with the precise type of information that is required.

The final model should proceed by identifying specific practicability problems and dividing these into their constituent events and sequences, with each discussed separately.

7. Preparing Alternative Options

Having identified and defined the practicability problems, alternative options for solving them should be proposed (see Table XII-6). The alternative should be

TABLE XII - 5

RECONCILING DESCRIPTIONS AND PREPARING FINAL MODEL

	Agreed	Disagreed	More Info Needed	DOE Conclusion
Practicability Program				
A. Events				
1				
2				
3				
B. Events				
1				
2				
3				

Source:

CECA

TABLE XII - 6

PREPARING ALTERNATIVE OPTIONS FOR PRACTICABILITY PROBLEMS:

	Necessary Societal Resources			Necessary Responses of Actors		Impacts of the Options	
Options	Institutional	Economic	Political	Actor 1	Actor 2 etc.	Energy Savings	Socioeconomic Environment etc.
1							
2							
3							

Source:

CECA

formulated on the basis of two sources of information: 1) the comparative and historical case studies and 2) the solutions suggested by the actors. They should outline the impact of each option in terms of the goals of the program.

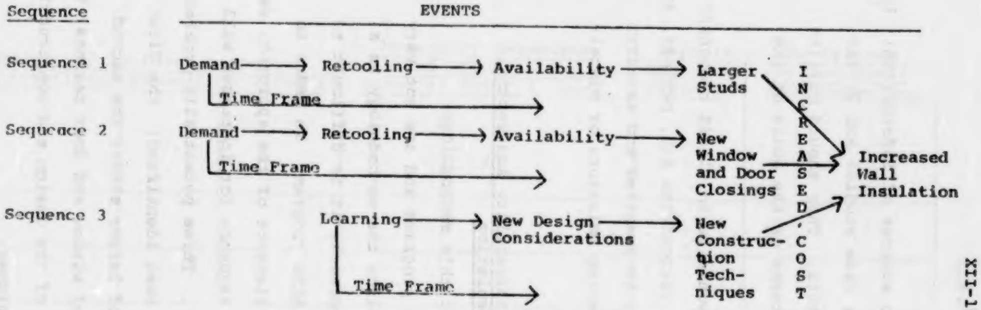
The final step would be to elicit responses from a sample of the original respondents and, perhaps, some new respondents. These should be compiled and assessed (as from step 5 above) and glaring omissions or miscalculations should be corrected.

C. An Example of a Practicability Assessment: Increased Wall Insulation

Existing examples of this methodology deal with social welfare type programs and are not very relevant to BEPS. Further, since the methodology is a reality-oriented and based approach, it is difficult to fabricate an example for the BEPS program. In order to illustrate some of the basic elements of the approach, we present a hypothetical event sequence for increased wall insulation (see Figure XII-1). Three potentially problematic sequences of events have been identified: the first deals with the availability of larger studs; the second deals with the availability of window and door casings; the third deals with the ability of the design and construction industries to adopt new techniques.

FIGURE XII - 1

POTENTIALLY CRITICAL EVENT SEQUENCES IN ACHIEVING INCREASED WALL INSULATION


Sequence
EVENTS
Sequence 1
Demand
Retooling
Availability
Larger Studs
Time Frame
Sequence 2
Demand
Retooling
Availability
New Window and Door Closings
Time Frame
Sequence 3
Learning
New Design Considerations
New Construction Techniques
Time Frame
INCREASED COST
Increased Wall Insulation

Sequence	COMMUNITIES TO BE SURVEYED			
Sequence 1 and Sequence 2	Consumers Code Officials	Manufacturers Financial Institutions	Marketing Delivery System	
Sequence 3		Labor Unions Builders	Design Profession	Labor Builders Financial Institutions Real Estate Industry

Source:

CECA

It can be argued that each of these sequences (and perhaps others) must come together in the proper order and time relationship in order to achieve widespread use of increased wall insulation. BEPS might help solve the initial problem -- ensuring that a demand exists -- but it could not ensure that the other events would occur as needed. What the practicability assessment would do is identify specific responses necessary to have the event sequences occur. Let us take a few examples:

a. Since BEPS does not mandate specific conservation strategies, the response of consumers to buildings with thicker walls might be tested to estimate the likelihood that increased insulation will be chosen as a conservation strategy. Building codes and code officials need to be surveyed in order to establish the health and safety implications of thicker walls. These two factors -- what consumers are likely to want and what building codes are likely to allow -- can be used to gauge demand.

b. Manufacturers could be surveyed as to the level of demand that would trigger a response on their part. The time necessary to alter products and the cost of doing so would also determine the actual production of the necessary materials. Financial institutions can also be surveyed in an effort to evaluate the cost/benefit of retooling.

c. Labor unions, which are ultimately responsible for certifying skills, can be surveyed to evaluate the necessary changes in building techniques and their cost implications. In addition, they can estimate the learning time required to effect a general change in construction techniques. Design professionals can be surveyed to make similar estimates with regard to the response of the professional.

d. Needless to say, the response of builders is vital to achieving increased wall insulation. Their concerns -- the cost of labor and materials, the difficulty of quality control of new techniques, the long-term performance of the building, etc. -- need to be recorded and evaluated. If builders, as a rule, are unwilling to use the technique, then demand for materials will not be great. If financial institutions and/or the real estate industry doubt the technical merits or cost-effectiveness of the technique, then its use will be inhibited.

The difficult part of providing a hypothetical example is predicting what the responses of the various communities will be. A hypothetical example of the final practicability model of increased wall insulation that might emerge after assessing responses is provided in Figure XII-2. This pattern of responses has been fabricated to stress three points.

Figure XII-2

THE FINAL PRACTICABILITY MODEL

	Demand	Retooling	Availability	
Sequences 1 and 2	Consumers exhibit strong preference for increased insulation over other conservation approaches. Consumers exhibit a willingness to trade-off aesthetic appeal of residence in return for lower energy costs. Building codes are indifferent to the amount of insulation in walls.	Profitability of larger studs occurs at X million board feet per year for average sized mill. Retooling takes the average mill 3 months. Profitability of larger casings occurs at X million units per year for average sized producer. Retooling takes the average producer 6 months.	Marketing and delivery take 2 months after retooling for both mills and other producers.	
		Learning	New Design Consideration	New Construction Techniques
Sequence 3		Only minor alterations in construction practices. On-site training will be adequate to learn new techniques. Builders express concern over quality control of installation.	Design is only slightly affected by increased wall thickness. 3 months necessary for mass produced designs to incorporate increased insulation.	Builders doubt cost effectiveness of increased insulation. Builders raise objections due to impact of increased cost on demand for housing. Financial institutions exhibit willingness to take operating costs into account. Real estate industry doubts aesthetic acceptability of thick-walled houses.

Source:

CECA

a. There are certain hard, economic and technological "facts" that can be discovered. Thus, we can predict with some precision the point at which retooling becomes profitable and how long the retooling process takes. In a strict definition of "maximum practicable improvement," the technical limits of what can be done determine the limits of practicability.

b. There are also attitudinal or preferential "realities" that can be discovered. The sensitivity of builders to increased first costs would certainly be revealed. Similarly, the real estate industry's concern with the aesthetics of housing would also be evident. These should be noted and steps to alter them could be taken via educational campaigns, but they should not be used to set the limits of practicability. It is exactly these obstacles that the BEPS program is intended to overcome.

c. There are certainly going to be differences of opinion over specific issues. For example, builders and labor may differ over the possibility for and impact of new construction techniques. In determining the validity of conflicting points of view, DOE must consider other sources of information, i.e., its historical and comparative case studies, the experiences of other programs and demonstration projects, and expert opinions.

In this hypothetical example we would conclude that increased wall insulation would be a practicable conservation option within 8 months of the issuance of the standards, since we would expect the standards themselves to create adequate demand for increased insulation.

D. Conclusion

We recognize that the research program outlined above is a large one to propose at this late date. However, it can be argued that this should have been DOE's program of research in the first place. After years of technical and economic research, DOE made the final decisions on the basis of essentially undocumented practicability considerations. Moreover, DOE has clearly expressed plans to continue major research efforts, especially in the technical and economic areas. We believe that there is still time to shift the focus to where it properly belongs -- to the social/institutional question of practicability.

More fundamentally, we recognize that no complex social question, such as the limits of "maximum practical improvement in energy efficiency," can ever be defined with perfect clarity and no social scientific methodology can ever provide absolute certainty in its results. The methodology we have outlined is intended both to provide a reasonable evidentiary basis for setting energy budgets at a systematically derived limit of practicability and to serve as a guide for altering those limits.

In the final instance, DOE's attitude toward this exercise will go a long way toward determining its utility. For the methodology to be effective, DOE will have to believe that such a systematic evidentiary base is necessary -- we believe it is -- and it will have to be willing to stress the word "maximum" in its approach so that the groups involved are truly pushed to grapple with the prospect of rapid change. Unless DOE takes this attitude, the exercise will degenerate into the facile verification of preconceived notions and self-interested opinions.

Part Four:

AN ALTERNATIVE APPROACH TO BUILDING ENERGY PERFORMANCE STANDARDS

CHAPTER XIII

AN ALTERNATIVE FRAMEWORK FOR POLICYMAKING

A. The Elements of the Framework

Throughout this report we have offered criticisms of the BEPS analysis on two levels. One level involved the empirical work performed by DOE. The second involved the principles by which the program was organized, specifically, the principles on which decisions were based. In fact, if there is one thing that the entire program seems to lack, it is an overall sense of organization, a rationale for making and integrating decisions. Because CECA believes that criticism without the statement of an alternative is destructive and hollow, this chapter proposes a complete alternative approach to the BEPS analysis and offers a specific scenario for setting energy budget levels.

CECA's alternative is based on two central empirical observations. First, a realistic estimate of fuel prices renders virtually every form of energy conservation investment cost-justified. Second, the technology currently exists to construct buildings which use between 50 and 75 percent less energy than the nominal BEPS building would use. We are not talking about building hermetically sealed fortresses (although even those are probably cost-justified). Rather, we are talking about building well-insulated, tight buildings that take maximum advantage of passive and active solar energy and utilize mechanical devices which reduce energy consumption.

However, we recognize that before the average homebuyer arrives at that maximally efficient house, declining marginal returns, rising first costs and practical problems would probably convince him/her that enough of a conservation investment had already been made. Moreover, we recognize that BEPS cannot mandate precisely the type of buildings that must be built. Thus, we need to decide within the limits of what is technically feasible and economically justified the level at which energy budgets can reasonably be set. We need a series of decision rules. These decision rules must blend five sets of considerations. 1/

1. What is Technically Feasible?

This approach is often called the engineering approach. It deals with the thermodynamics of buildings

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1/ America's Energy Future (p. 13), mentions three alternative approaches -- the economic, the thermodynamic and the moral. These correspond to CECA's first three sets of considerations. Most of the other national studies reviewed in Chapter II also mention these three approaches. Neither the national studies nor DOE has endeavored to integrate the different approaches into a systematic framework for policy analysis. CECA believes that this integration is essential if rational policy decisions are to be made.

and defines, according to available technology, the minimum level of energy that could be used to heat and cool buildings to comfortable temperatures.

2. What is Economically Justified?

This approach involves life cycle cost or other economic analysis and determines, usually through an optimizing framework, the level of investment in conservation that is economically justified .

3. What is Socially Desirable?

This can be called the moral approach. It deals with the social value that is placed on both conservation and patterns of energy consumption. The moral approach defines how little energy ought to be used on the basis of social values and goals.

4. What is Practicable?

This can be called the pragmatic approach. It looks at the institutional arrangements in the real world and defines, given the reality of 40,000 diverse builders and 100,000 diverse building inspectors, the level of expertise of building designers, the capabilities of the building material industry, and what can realistically be accomplished in energy conservation in the shells of new buildings.

5. What is the Value of a Regulatory Program?

This can be called the national value approach. It looks at the cost of administering the program, the over-

all benefits it will produce and the possibility that progress will be made in the absense of the program. This is a summing-up of the previous four factors, but the summing-up is sufficiently important to warrant special consideration. Simply put, if the technical and economic factors are pushing strongly toward the social goals and if practicability is not a major obstacle, then the administrative and economic costs of setting up a special regulatory program may not be worthwhile. On the other hand, if the economic incentives for conservation are weak and the obstacles to conservation large, or if the social goal demands a very rapid response, then the administrative effort will be easily justified.

DOE has blended these factors in its analysis, but it has not done so in a systematic fashion. Above all, research and decision-making should be conducted in such a way that the priority placed on each of these factors is clear and the costs and benefits associated with these priorities are made known. DOE's analysis leaves both the priorities and cost/benefits unclear. CECA's approach to BEPS places different priorities on each of the factors and organizes them in such a way that the implications of the priorities can be easily ascertained.

B. The Limits of Technical Feasibility

Our discussion of the various conservation options (see Chapters IV - VII) shows that a great deal more conservation than DOE has mandated is technically feasible. The potential contributions of each of the conservation measures for single family residences that have been reviewed throughout this report are summarized in Table XIII-1. Our task would be very easy if we were able simply to total the energy savings from each option in order to arrive at what is technically feasible. Unfortunately, the thermodynamics of buildings are too complex for that. However, we can get a rough idea by combining those features which appear to be most directly additive. This is partly a speculative exercise, but it produces very realistic results.

We use Minneapolis as an example, since DOE has examined the various conservation options most carefully for that geographic location (a principle of future analysis should require an examination of each option for each location, so that a complete set of information is generated). Furthermore, we add the options in the order of their apparent cost-effectiveness (as an exception, we begin with nominal BEPS insulation, because it has been consistently used as the base in DOE's analysis). This ordering can be guessed by ranking the individual options according to the present value per million BTU's at which the net present value of the investment goes to zero (see Table XIII-2). It should be noted that a certain amount of interaction is

TABLE XIII - 1

POSSIBLE IMPROVEMENTS BEYOND NOMINAL BEPS
(as % reduction of space condition energy use
in gas heated buildings)*

	Tight Bldgs.	Free Passive Solar	Max. Insul.	Night Setback	Heat Shutters	Solar Hot Water
Minn.	36	23	21	--	6	32
Chicago	35	7.6	28	11	--	33
Portland	35	13	--	--	--	38
Wash. D.C.	30	10	30	--	7	31
Atlanta	25	14	--	11	--	18
Fresno	33	31	--	--	12	43
Burbank	--	21	--	22	--	50
Phoenix	10	7	--	--	--	39
Houston	--	9	--	--	--	36
Ft. Worth	20	8	--	--	10	32

Source:

Economic Analysis, passim.

Passive and Active Solar Analysis, passim.

*While solar hot water is not cost-effective with respect to gas in DOE's analysis, the fuel price escalation rates necessary to make it cost-effective are below those we estimate as being realistic. By the same token, all active solar systems would be cost-effective at the escalation rates that we project for electricity.

TABLE XIII - 2

DERIVING THE MAXIMALLY EFFICIENT HOUSE IN MINNEAPOLIS

	Present Value/MMBTU* at which NPV=0	% Reduction against BASE*	LEVEL OF ENERGY CONSUMPTION: Total Gas MMBTU's/sq.ft./yr	LEVEL OF ENERGY CONSUMPTION: Gas BTU's Adjusted for furnace efficiency (Actual Space Conditioning BTU's)
1975 Practice	--	--	68	47.6
Nominal BEPS Insulation	60	23	52.1	36.5
Low Infiltration**	21	36	40.8	28.4
Super Insulation	173	21	32.3	22.4
Optimum Passive Solar	277	35	20.9	15.6
Optimum Active Solar ***	331	27	15.3	11.3

Source:

Chapters IV - VII.

* Options not included separately but explored in this report have the following present values and % reductions: Night setback, $20, 11%; Passive Solar to 20%, $103, 20%; Active Solar Hot Water, $189, 38% (with a base of gas); Active Solar Space and Hot Water, $300, 51%; Heat Shutters, $422, 6%.

** Since low infiltration has been directly analyzed in the BEPS program, this provides the staring point for applying additional % reductions.

*** With Electricity as a competing fuel.

being taken into account in this approach, since we apply the percentage reductions to the prior level of energy use, i.e., we use a declining base. We arrive at a rather low level of energy use compared to either 1975 practice or nominal BEPS. We estimate that the maximally energy-efficient building would use between 10 and 15 MMBTU's/sq. ft./yr.

To ascertain whether these estimates of the limits of technical feasiblity are realistic, we have compared them to a recent review of energy-efficient housing (see Table XIII-3).[2] After converting energy use to BTU/sq. ft./degree day, and using the figures adjusted for the efficiency of the gas system, we find that the estimates of energy use are quite close to those that are actually being achieved in super-efficient housing.

If we take a broader view, comparing the CECA calculations for the Minneapolis house to a number of other houses and the pathways along which very low levels of energy use have been achieved, we find equally reassuring results (see Figure XIII-1). The starting point for 1975 practice is somewhat low, but this is of no concern, since it is merely a number imputed from the BEPS analysis. Given the low starting point, the increments in energy reduction associated with each additional option are somewhat truncated, but the proportions seem to be generally correct.

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[2] Mark Christensen, Charles Drucker and Jim Harding, "Special Section on Energy-Efficient Housing: An Overview and Outlook," Soft Energy Notes, 3:1, Feb. 1980. Hereafter referred to as "Special Section on Energy-Efficient Housing."

Basic insulation, as well as low infiltration, makes a large contribution to conservation. Passive solar reduces energy use somewhat less than low infiltration and active solar somewhat less than passive. The CECA house would incorporate much the same equipment as the Saskatchewan houses (the lowest level of energy use depicted in Figure XIII-1) and it arrives at a similar level of energy use. Thus, the increments seem to parallel the "Canada line" fairly closely.

The conclusion we can safely reach is that the technically feasible level of energy use for space conditioning is on the order of 1 BTU/sq. ft./d.d., which translates, in Minneapolis, to roughly 10 MMBTU's/sq. ft./yr for a house of the size used in the BEPS analysis.

As the review of super-efficient houses argues:

> The series of points labeled N.J. represent houses at Twin River, New Jersey, currently monitored by Princeton University...they demonstrate the enormous energy savings potential of retrofits. This performance, combined with that of Leger's house, the

TABLE XIII - 3

COMPARING EFFICIENT HOUSES

House Type	Space Heating Requirements Fuel or Solar Collectors *		
	$kJ/m^2/^oC$-d		$Btu/ft^2/^oF$-d
1973 House	390.4		19.1
1976 House	312.7		15.3
ERDA Pacific Solar Handbook	163.0		8.0
AAchen House (active solar)	70.5		3.4
Trombe Wall - Kelbaugh House	55.2		2.7
Leger House	48.1		2.4
Brownell House	34.1		1.7
Lyngby House (active solar)	18.3		.9
Saskatchewan House (active solar)	4.5		.22
CECA maximum conventional plus optimum solar.	1.8		(1.8)
CECA maximum conventional plus Passive and active solar	1.3	1.8	(1.3)

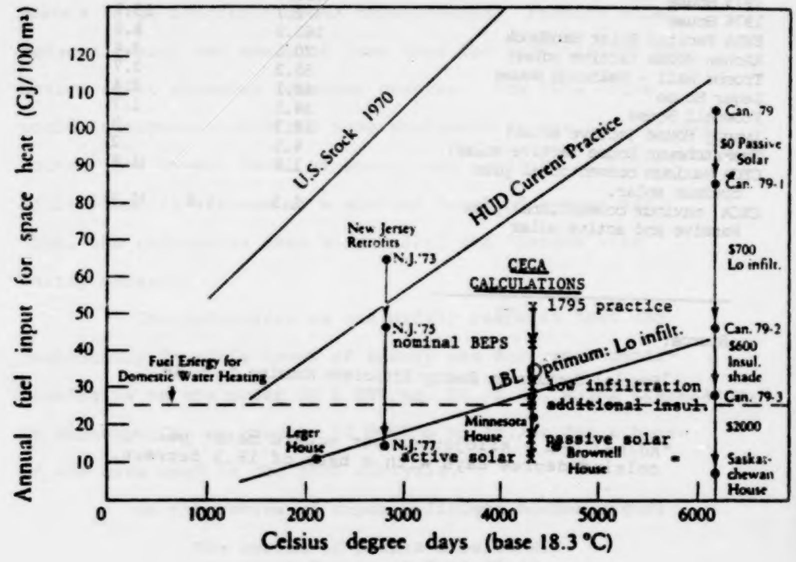
Source:

"Special Section on Energy Efficient Housing," p. 18.

$^*kJ/m^2/^\circ C$-d = kilojoules per square meter per celsius degree days with a base of 18.3 degrees.

FIGURE XIII-I

ACHIEVING SUPER-EFFICIENCY IN RESIDENTIAL SPACE HEATING



Source:
"Special Section On Energy-Efficient Housing", p. 19.

> **Saskatchewan house, and a Minnesota design, clearly set a new energy consumption standard for space heating: a level half that of the energy used for domestic water heating! Such performance is possible for both new housing and some retrofits.** [3]

C. Economic Analysis

Economic analysis involves taking the straight line of the pathway of reduced energy use depicted in Figure XIII-1 and bending it into a life cycle cost curve. This entails balancing the value of the BTU's saved by each option against the cost of saving them. On the basis of the data at hand, a rough estimate of a life cycle cost curve is presented in Figure XIII-2. The shape is slightly distorted because nominal BEPS insulation is incorporated "out of turn." In Figure XIII-3, we present hypothetical curves for each fuel as well as sensitivity tests for each of the fuels analyzed.

A number of observations about the curves should be made.

1. Each fuel price has been set at the level of delivered energy for space conditioning. That is, we have

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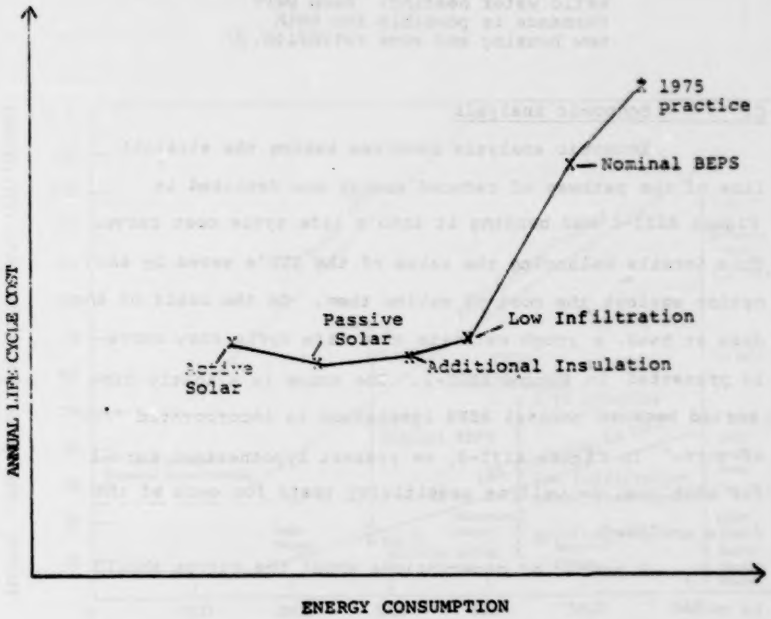
[3] "Special Section on Energy-Efficient Housing," p. 19.

FIGURE XIII-2

A HYPOTHETICAL LCC CURVE
FOR THE OPTIMUM MINNEAPOLIS HOUSE

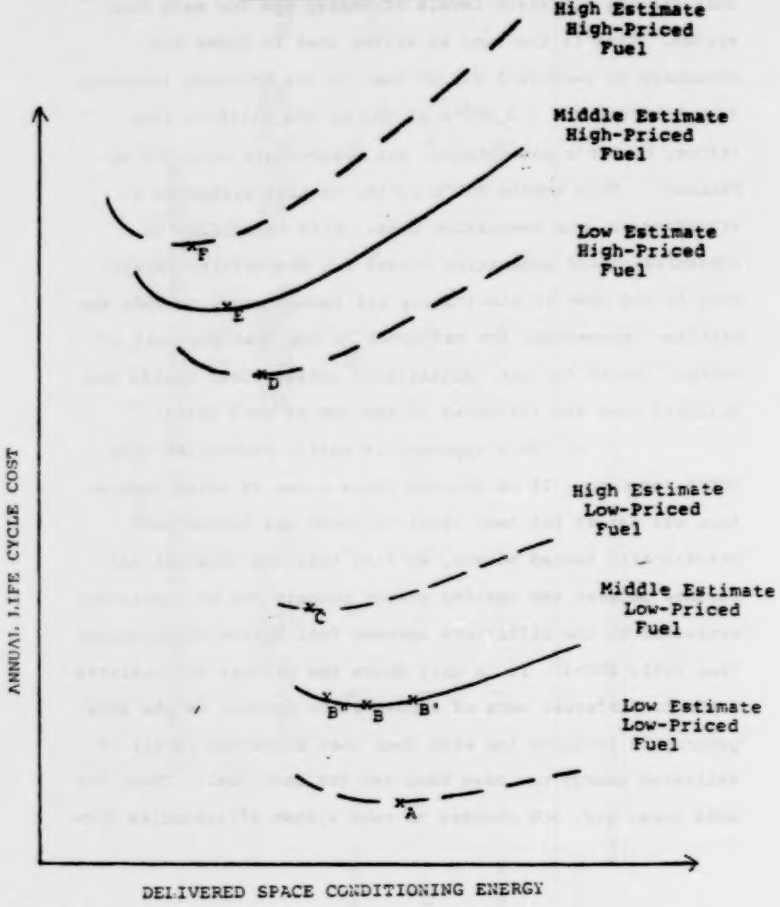


Source:

CECA

FIGURE XIII-3

HYPOTHETICAL LCC CURVES WITH HIGH AND LOW FUELS PRICES AND SENSITIVITY TESTS



Source:

CECA

factored fuel system efficiency into the fuel price, rather than stating different levels of energy use for each fuel system. This is the same as saying that in order for consumers to receive 1 BTU of heat in the building interior, they must pay for 1.3 BTU's of gas at the building line (since, by DOE's assumptions, gas systems are only 70% efficient). This treats BTU's in the heating system as a transmission and generation loss. This is similar to transmission and generation losses for electricity except that in the case of electricity all losses occur outside the building (therefore, are reflected in the cost-per-unit of energy), while for gas, significant losses occur inside the building (and are reflected in the use of more units).

a. This approach is easily reconciled with DOE's approach. If we examine those cases in which insulation was set at the same level for both gas heated and electrically heated houses, we find that the apparent difference between the heating energy budgets can be completely explained by the difference between fuel system efficiencies (see Table XIII-4). It is only where the partial LCC analysis leads to different sets of conservation options in the same geographic location for each fuel that different levels of delivered energy use have been set for each fuel. Thus, for some locations, DOE chooses to take system efficiencies into

TABLE XIII - 4

THE RELATIONSHIP BETWEEN GAS AND ELECTRIC ENERGY BUDGETS

	Insulation			Gas Budget Heating Load	Electric Budget Heating Load	Electric/Gas
	Ceiling	Wall	Glass			
Minneapolis	38	25	3	52.1	36.5	.70
Phoenix	38	19	3	2.1	1.5	.71
Fort Worth	38	17	3	8.5	5.9	.69

Source:

Energy Budget Level Selection, p. B-2.

account by adjusting energy budgets; CECA chooses to take them into account by adjusting fuel prices to reflect actual BTU's delivered for space conditioning. For the consumer, this is a more realistic approach since the consumer measures energy consumption in terms of dollars paid (not BTU's) to achieve a specific level of space conditioning. This approach also seems consistent with the design approach. The first thing that is calculated by designers is the thermodynamics of the building. The HVAC equipment is then fit into the building (taking its efficiency into account).

2. Another point to be noted about the curves is that as fuel prices increase, the curves become steeper (reflecting larger marginal returns to investments of equal cost) and the optima are reached at lower levels of energy use in BTU's.

3. We have identified two non-optimal points, B' and B", on the middle estimate for the low-priced fuel. These two points have equal life cycle costs, but very different energy use levels. Both points are "economic" in the sense that they have lower life cycle costs than the first point on the curve (current practice). However, point B' errs on the side of caution (with the consumer investing less in conservation than current fuel price estimates suggest is optimal), while point B" errs on the side of conservation (with the consumer investing more in conservation

than current fuel price estimates suggest is optimal). Should fuel prices prove to be closer to the low estimate, B' would be close to the optimum. Should fuel prices prove to be closer to the high estimate, B" would be close to the optimum. Given the intent of the law which created BEPS and the critical nature of today's energy situation, we believe it is preferable to err on the side of conservation. Point B" guarantees low energy consumption and insulates the consumer against the vagaries of an uncertain energy situation.

The actual shape and location of the curves can be inferred by examining the marginal costs and marginal benefits of each of the conservation options (see Table XIII-5). In order to make these calculations, we have used the cost figures provided in Chapter VII and calculated the marginal reduction in energy use for each option as it is added on the path to the super-efficient house. Keeping in mind that a mid-range estimate of the present value of gas is $265 ($359 after adjustment for fuel system efficiency) and a mid-range estimate for electricity is $663, it can be seen that adding options up to passive solar would result in a large positive economic benefit. Moreover, the cost figures for passive solar have not been adjusted for the first 44 feet of "free" glazing, so it, too, would certainly be cost-

TABLE XIII - 5

MARGINAL COSTS OF CONSERVATION INVESTMENTS

Conservation Option	Marginal Cost $	Marginal Energy Saving MM BTU	PV Where NPV=0, at The Margin ($/MM BTU)
Nominal BEPS Insulation	1155	18.7	61.7
Low Infiltration	500	13.3	37.6
Super Insulation	733	10.0	73.3
Optimum Passive Solar	2646	13.4	197.4
Optimum Active Solar	5500	6.6	833.3
(Optimum Active Solar excluding Passive Solar)	(5500)	(10.2)	(539.2)

Source:

Chapters IV - V.

justified at the margin. None of these costs take tax incentives into account.

To estimate the total system cost, we add the present value of fuel to the capital costs (see Table XIII-6). For gas, this produces a curve with an optimum point at the passive solar option. Super-insulation has the second lowest life cycle cost. For electrically heated houses, we also have an optimum at the passive solar house, but the super-efficient house has the second lowest life cycle cost.

If we perform a rough sensitivity analysis by doubling the cost of capital (which is only slightly higher than realistic) the differences between gas and electricity become more distinct. Under this scenario, gas optimizes at the point of super-insulation, while passive solar is only slightly below low infiltration in terms of life cycle cost. The active solar systems have life cycle costs above nominal BEPS. The house heated by electricity with high conservation capital cost optimizes at passive solar, with active solar well below nominal BEPS in terms of life cycle cost. We believe that the high capital cost, mid-range fuel price curves are quite realistic.

D. Social Considerations

There is a simple way to incorporate social considerations into the economic analysis. The price of the critical fuel or fuels can be adjusted upward or downward

TABLE XIII - 6

LCC COST OF CONSERVATION OPTIONS

	Energy Use	PV of Fuel($)		Capital Cost($)		TOTAL LCC COST			
	(MMBTU/yr)	Gas ($359)	Electric ($662)	BEPS	2xBEPS	Gas + BEPS Capital	Gas + 2xBEPS Capital	Electric+ BEPS Capital	Electric+ 2xBEPS Capital
1975 Practice	79.9	28684	52894	--	--	28684	28684	52894	52894
Nominal BEPS	61.3	22007	40581	1155	2310	23162	24317	41736	41736
Low Infiltration	48.0	17232	31776	1655	3310	18887	20542	33431	35086
Super Insulation	38.0	13642	25156	2388	4776	16030	18418*	27544	29932
Passive Solar	24.6	8831	16285	5034	10068	13865*	18899	21319*	26353*
Active Solar	18.0	6822	11916	10534	21068	17356	27890	22450	32984
(Active Solar without Passive Solar)	(27.6)	(10460)	(18271)	(7888)	(15776)	18348	26236	26159	34047

Source:

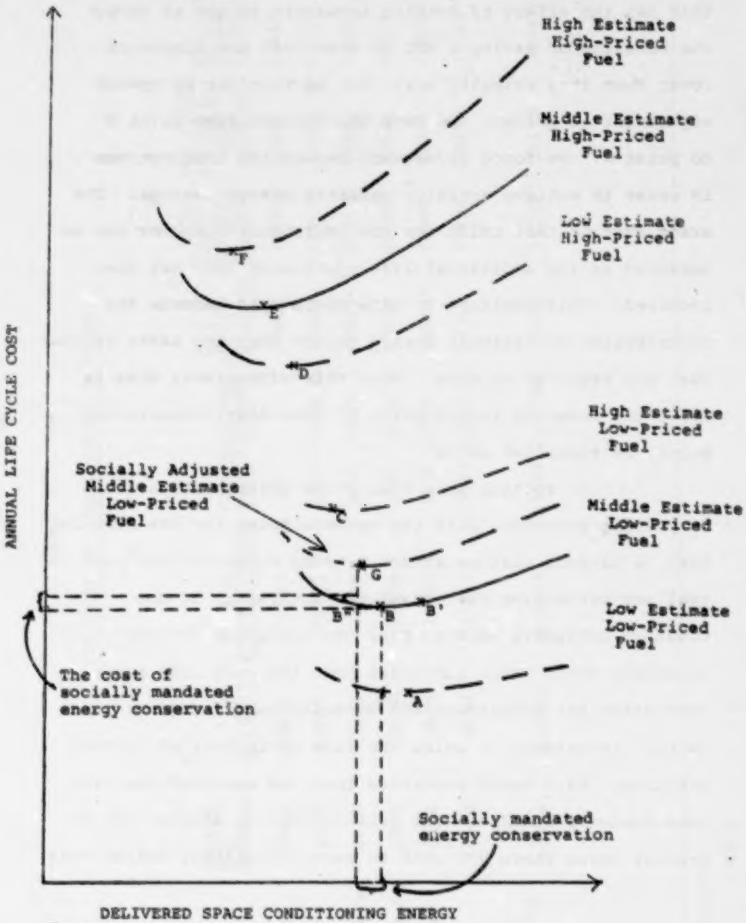
CECA

to reflect the social value placed on it (see Figure XIII-4). This has the effect of forcing investors to act as though the benefits of saving a BTU of that fuel are higher or lower than they actually are. Let us consider an upward adjustment in prices. We move the optimum from point B to point G. We force investment beyond its true optimum in order to achieve socially mandated energy savings. The exact cost of that shift for the individual consumer can be measured as the additional life cycle cost that has been incurred. This addition to life cycle cost becomes the contribution to national energy policy that the users of that fuel are required to make. What this effectively does is drive the investor toward point B" (the high conservation point) as specified above.

In setting this fuel price adjustment, i.e., in pushing investors past the optimum point for the critical fuel, a balance must be struck between achieving the social goal and protecting the consumer's interest. If one class of consumers were to bear the burden, a minimal principle would be to guarantee that the real life cycle cost after the adjustment for socially mandated non-optimal investment is below the life cycle cost of current practice. This would guarantee that the consumer realized some economic benefit. The calculations in Chapter VII of present value where NPV goes to zero effectively define this

FIGURE XIII-4

THE LCC ANALYSIS OF SOCIALLY MANDATED CONSERVATION


High Estimate
High-Priced
Fuel
Middle Estimate
High-Priced
Fuel
Low Estimate
High-Priced
Fuel
F
E
D
ANNUAL LIFE CYCLE COST
High Estimate
Low-Priced
Fuel
Socially Adjusted
Middle Estimate
Low-Priced
Fuel
C
Middle Estimate
Low-Priced
Fuel
G
B"
B
B'
Low Estimate
Low-Priced
Fuel
A
The cost of
socially mandated
energy conservation
Socially mandated
energy conservation
DELIVERED SPACE CONDITIONING ENERGY

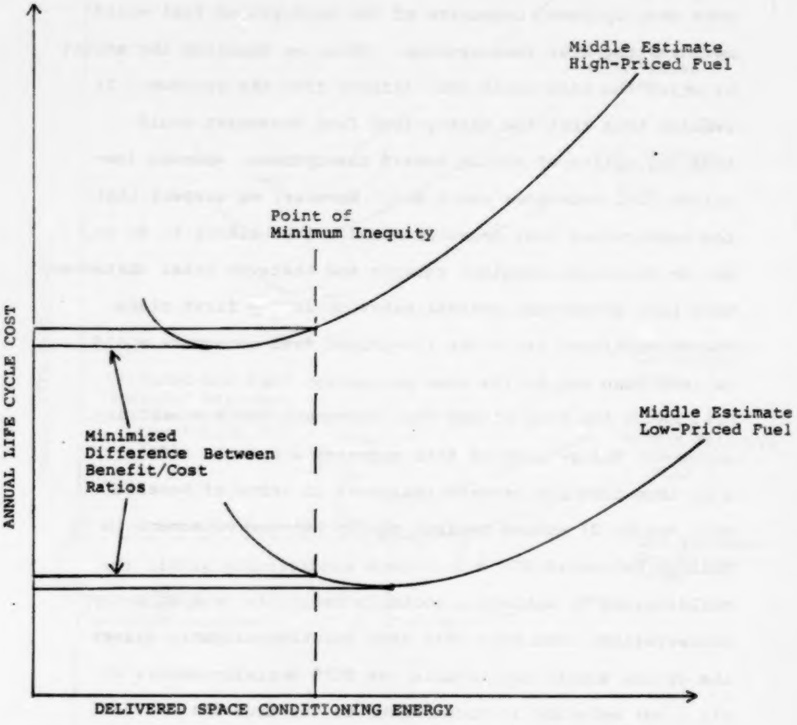
Source:
CECA

point. A better principle would be to equalize the margin by which consumers of each fuel miss the optimum (see Figure XIII-5). Consumers of the low-priced fuel would be investing more than optimum; consumers of the high-priced fuel would be investing less than optimum. Thus, we equalize the amount by which the life cycle cost differs from the optimum. It remains true that the high-priced fuel consumers would have the option of moving toward the optimum, whereas low-priced fuel consumers would not. However, we suspect that the high-priced fuel consumer would not be likely to do so, due to declining marginal returns and whatever other obstacles have been preventing optimal behavior in the first place. The benefit/cost ratio for low-priced fuel consumers would be less than one by the same percentage that the benefit/cost ratio for high-priced fuel consumers would exceed one.

The results of this approach are to 1) create a minimum inequity between consumers in terms of benefit/cost ratio; 2) ensure perfect equity between consumers in maximum delivered BTU's for space conditioning within the building; and 3) achieve a socially desirable rate of energy conservation. The fact that this solution slightly misses the optima should not trouble the BEPS decision-makers at all. Our solution is much closer to the true optima than the original DOE decision; it creates less inequity in both benefit/cost ratios and fuel use; and it results in greater

FIGURE XIII-5

MINIMIZING LCC INEQUITY BETWEEN USERS OF DIFFERENT FUELS



Source:

CECA

conservation.

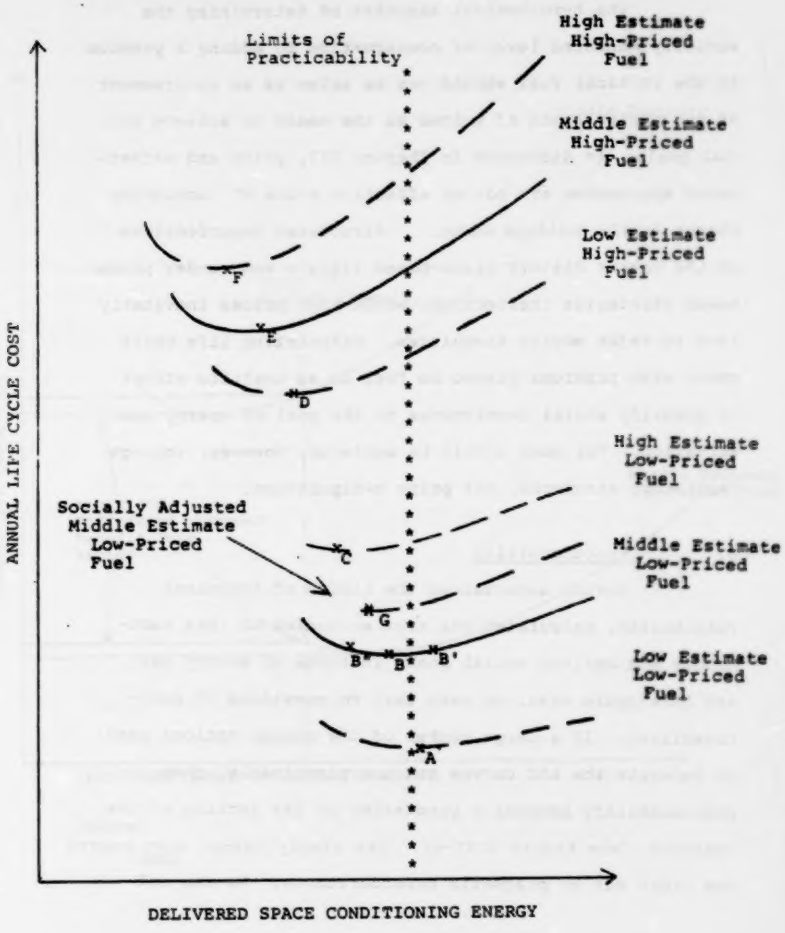
The hypothetical exercise of determining the socially mandated level of conservation by adding a premium to the critical fuel should not be taken as an endorsement of the manipulation of prices as the means to achieve social goals. As discussed in Chapter III, price and market-based approaches are not an effective means of achieving change in the buildings sector. Structural imperfections in the market distort price-based signals and render price-based strategies ineffective, while high prices inevitably lead to major social inequities. Calculating life cycle costs with premiums placed on fuel is an analytic effort to quantify social commitments to the goal of energy conservation. The goal should be achieved, however, through regulatory standards, not price manipulation.

E. Practicability

Having ascertained the limits of technical feasibility, calculated the true economics of that technology and defined social goals in terms of energy use and life cycle cost, we next turn to questions of practicability. If a large number of the energy options used to generate the LCC curves are not practicable, then practicability becomes a constraint on the setting of the standard (see Figure XIII-6). One simply cannot move beyond the limit set by pragmatic considerations. We can and

FIGURE XIII-6

PRACTICABILITY AS A CONSTRAINT ON ENERGY CONSERVATION



Source:
CECA

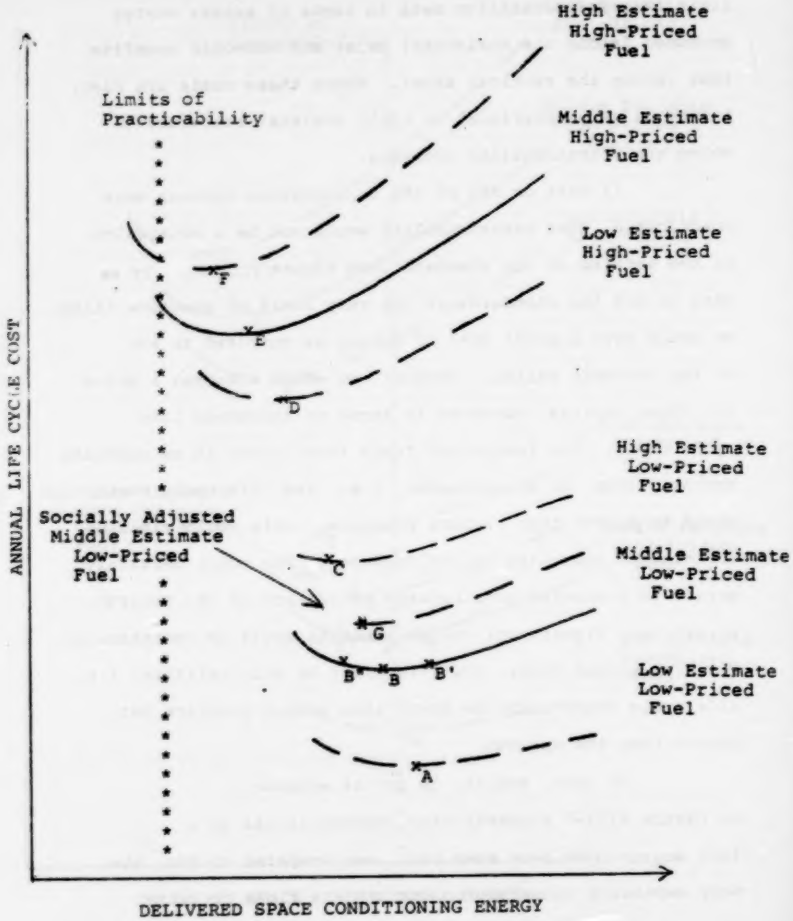
should, however, calculate the costs associated with the limit that practicability sets in terms of excess energy consumed (along the horizontal axis) and economic benefits lost (along the vertical axis). Where these costs are high, it may be very beneficial to apply societal resources to solve the practicability problems.

If most or all of the conservation options were practicable, then practicability would not be a constraint on the setting of the standard (see Figure XIII-7). If we were to set the standards at the very limit of practicability, we could save a great deal of energy as compared to any of the economic optima. However, we would also pay a price for those savings, measured in terms of increased life cycle costs. For low-priced fuels there might be an absolute economic loss to the consumer, i.e., the life cycle costs would be higher than current practice. This would violate our minimum guarantee to the consumer. One could certainly expect to encounter considerable resistance to the program, unless very significant social benefits could be demonstrated. For high-priced fuels, the loss might be only relative, i.e., life cycle costs might be lower than common practice but higher than the optimum.

In fact, reality is not as extreme as Figure XIII-7 suggests with respect to gas as a fuel source. We have seen that even compared to gas, the more expensive conservation options are close to cost-

FIGURE XIII-7

PRACTICABILITY AS A NON-CONSTRAINT ON ENERGY CONSERVATION



Source:
CECA

justified on an individual basis. Combining the options in a LCC approach, it seems safe to say that gas heated homes would optimize with packages that include nominal BEPS insulation, low infiltration and optimum passive solar with night insulation. Houses heated with electricity would optimize closer to the limits of technical feasibility. Further, it is very unlikely that even the super-efficient house, when heated with gas, would have a higher life cycle cost than common practice.

In addition to these considerations, which suggest that reality is not as extreme as Figure XIII-7 suggests, we believe that praticability does present a constraint on the level at which the standards should be set. Thus, a realistic picture of the situation would look more like Figure XIII-8. Given this picture of reality, the final question we must ask is whether or not a national regulatory program is necessary and worthwhile.

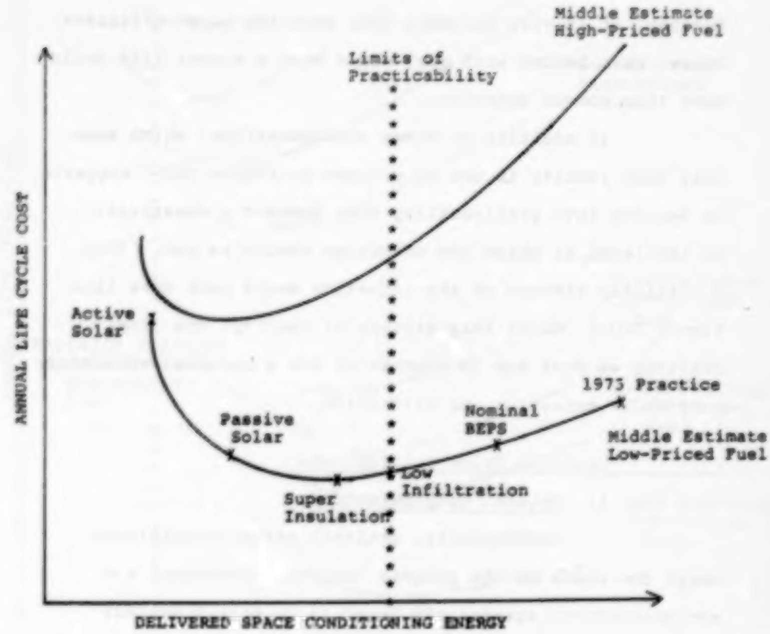
F. National Value Calculations

1. General Considerations

Conceptually, national value calculations weigh the costs of the program (capital investment and administrative) against the benefits in energy savings to be realized. Two different areas of concern can be identified (see Figure XIII-9).

FIGURE XIII-8

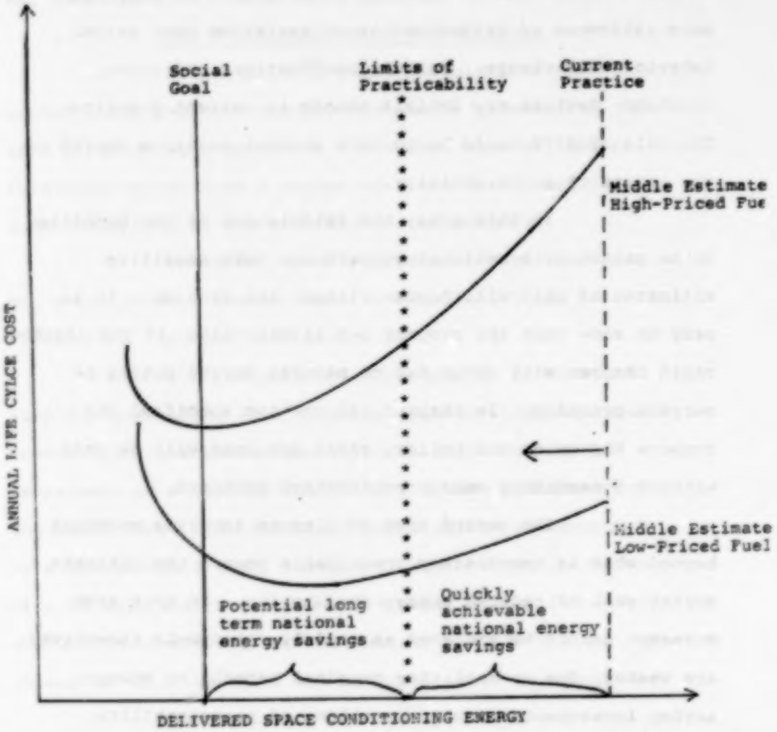
A REALISTIC PICTURE OF THE LCC ANALYSIS OF ENERGY CONSERVATION



Source:

CECA

FIGURE XIII-9
THE LCC BASIS FOR NATIONAL VALUE CALCULATIONS



Source:

CECA

The first area involves the movement from current practice to the limits of practicability. In this area, results should be quickly achievable. Economic incentives appear to be strong and technology is readily available. However, as demonstrated in Chapter III, the mere existence of incentives is no guarantee that actual behavior will change. Market imperfections and other structural factors may inhibit change in current practice. The role of BEPS would be to move current practice toward the limits of practicability.

In this area, the calculation of the benefits to be gained by a national program are very sensitive estimates of what will happen without the program. It is easy to show that the program has little value if one assumes rapid changes will occur due to natural forces acting on current practice. In Chapter III we have specified the reasons why we do not believe rapid progress will be made without a mandatory energy performance standard.

The second area of concern involves movement beyond what is immediately practicable toward the ultimate social goal of reduced energy consumption. In this area movement cannot be achieved as rapidly. Economic incentives are weaker, due to declining marginal returns to energy saving investment, and major problems of practicability exist. If the standards are set close to these social goals, the potential benefit of the program will be high, but so will its costs (in terms of necessary administrative efforts and social disruption) and the chances of its succeeding will be low. The social goals would have to be very visible and compelling to create rapid movement in this area.

2. DOE's National Value Calculations

DOE's national value calculations show a rather small positive contribution to be gained from the BEPS program, as proposed in the NOPR. However, the calculations suffer from a number of flaws which lead to an underestimation of the benefits of the program.

The model used to predict how quickly common practice will change rests on a different set of assumptions than the BEPS analysis.

a. The ORNL model assumes an 8% discount rate for investment in residential conservation equipment. However, DOE has based the optimization of residential investment on a 3% discount rate. To make matters worse, the macro-level national value calculations are executed at a 10% discount rate. With a micro-level optimization at a 3% discount rate, a baseline model at 8%, and a macro evaluation at 10%, it becomes extremely difficult to interpret the results of the national value calculation.

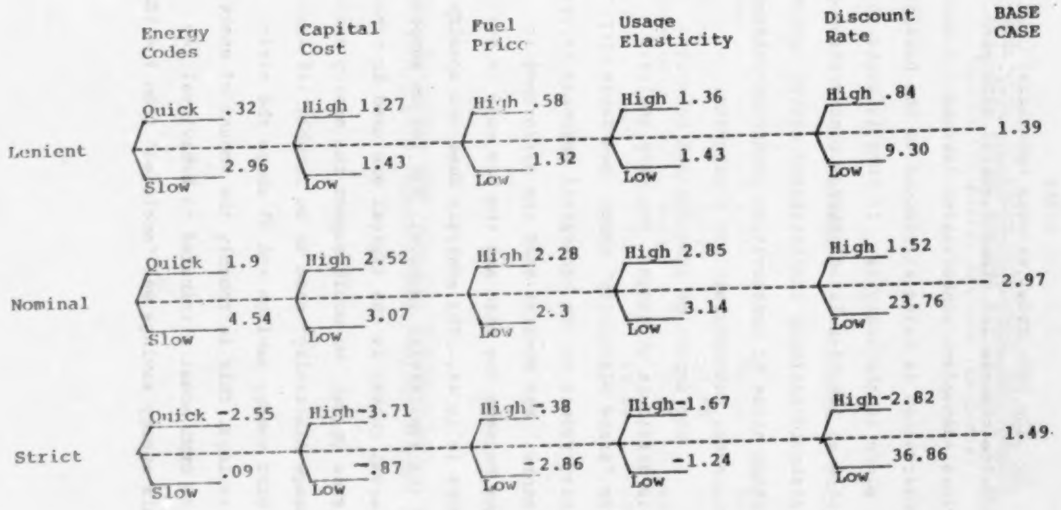
The importance of the inconsistency in discount rates can be seen most easily with respect to

DOE's national value calculation for the strict level of the standard (see Figure XIII-10). At a micro-discount rate of 3%, a good deal of investment takes place, but when one turns around and values that investment at a 10% discount rate, it has a negative net present value, i.e., it becomes uneconomic. At 10%, the strict standards have a net national present value of -$2.82 billion. At 3%, the strict standards have a net national present value of $36.86 billion. This is by far the largest positive net present value for the various levels of standards and sensitivity tests considered. This should come as no surprise. The program was optimized by DOE at the micro-level for this 3% case.

Jumping discount rates in this way is a simple, mathematical bias against high capital cost cases; it is not a sensitivity analysis. Each of the mathematical cases assumes that the same amount of energy would be saved regardless of the discount rate, which implies that the same amount of capital would be invested to save energy regardless of the discount rate. This is preposterous. A proper sensitivity analysis would "re-optimize" the micro-level at the higher discount rate and assess the national value of the energy savings resulting from the new optima.

FIGURE XIII - 10

RESIDENTIAL ENERGY BUDGET LEVEL DECISION TREE


Energy Codes
Capital Cost
Fuel Price
Usage Elasticity
Discount Rate
BASE CASE
Lenient
Quick .32
Slow 2.96
High 1.27
Low 1.43
High .58
Low 1.32
High 1.36
Low 1.43
High .84
Low 9.30
1.39
Nominal
Quick 1.9
Slow 4.54
High 2.52
Low 3.07
High 2.28
Low 2.3
High 2.85
Low 3.14
High 1.52
Low 23.76
2.97
Strict
Quick -2.55
Slow .09
High-3.71
Low -.87
High -.38
Low -2.86
High-1.67
Low -1.24
High-2.82
Low 36.86
1.49

Source:

Economic Analysis, Appendix D, pages D-2 through D-34.

b. The ORNL model assumes behavioral responses to price changes and other factors; BEPS precluded behavioral-dependent conservation devices. A certain amount of conservation is being attributed to the base case, which has no place in the analysis. If BEPS is going to define its scope as "shell-related" energy conservation only, then the base should estimate shell-related energy consumption only: other areas of conservation (behavior-related devices, appliances, automobiles) are irrelevant.

The impact of inconsistent behavioral assumptions is difficult to judge. The BEPS analysis contains three "usage elasticity" cases (see Table XIII-7). Usage elasticity refers to the behavioral response to price and other factors. For nominal BEPS the difference in energy savings between the high and the low case is 6%; for strict BEPS it is 4%. The analysis does not specify the breadth of the sensitivity interval, but let us suppose that the interval chosen is the typical one used in other sensitivity runs (± 30%). We would expect the energy savings from a "no usage elasticity" case to be roughly 14% above the nominal BEPS energy savings and 9% above the strict BEPS energy savings. This is roughly the amount of energy savings in the ORNL model attributed to behavioral responses. This energy savings was "excluded" from the BEPS

TABLE XIII - 7

THE IMPACT OF USAGE ELASTICITY ASSUMPTIONS ON ESTIMATED ENERGY SAVINGS ATTRIBUTABLE TO BEPS

Cumulative Energy Savings (in Quads)

	Lenient	Normal	Strict
High Elasticity	4.42	10.98	21.49
Moderate Elasticity (Base Case)	4.46	11.26	21.84
Low Elasticity	4.53	11.66	22.33
Very Low Elasticity	4.63	12.18	22.97
No Elasticity	4.76	12.86	23.80

Source:

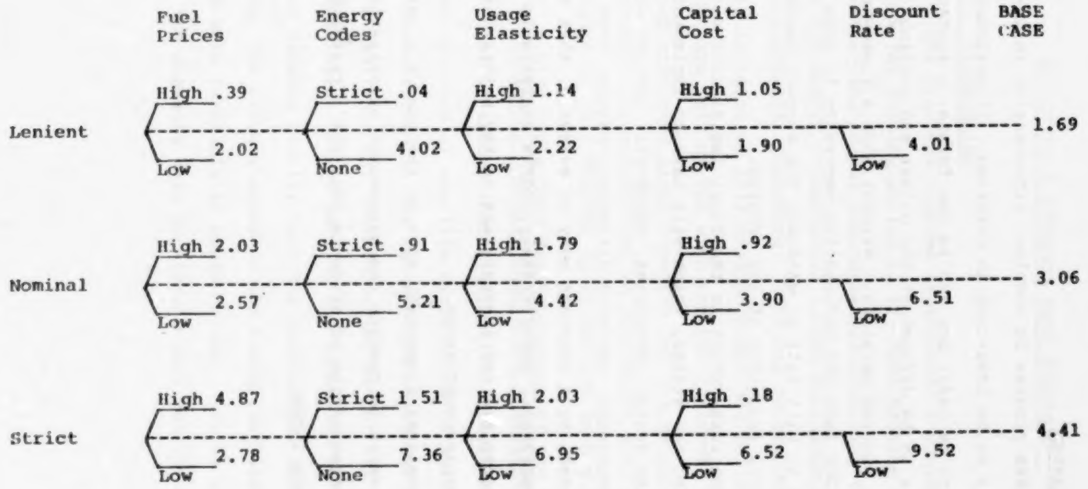
Economic Analysis, base case pp. D-2 thru D-4; High Elasticity pp. D-23 thru D-25; Low Elasticity pp. D-26 thru D-28.

program by assumption. Either it needs to be excluded from the ORNL model for purposes of comparison, or it needs to be included in the BEPS program as part of the setting of standards. In either event, the potential energy savings of BEPS has been underestimated by 10% or more.

c. For the commercial sector, the discount rate is consistent, but it is difficult to judge the consistency of assumptions between the ORNL model and the redesign exercise. However, for the commercial sector DOE's extremely conservative approach can be clearly seen without dissecting the numbers (see Figure XIII-11). In 9 of the 10 cases described by DOE, the strict standards have the highest present value to the nation. In the one case where it does not (high capital costs) it still has a positive present value. In light of these strong figures in support of a strict standard, it is clear that DOE has placed a great deal of weight on non-economic considerations in choosing the nominal standards.

FIGURE XIII - 11

COMMERCIAL ENERGY BUDGET DECISION TREE


Fuel Prices
Energy Codes
Usage Elasticity
Capital Cost
Discount Rate
BASE CASE
Lenient
High .39
Low 2.02
Strict .04
None 4.02
High 1.14
Low 2.22
High 1.05
Low 1.90
Low 4.01
1.69
Nominal
High 2.03
Low 2.57
Strict .91
None 5.21
High 1.79
Low 4.42
High .92
Low 3.90
Low 6.51
3.06
Strict
High 4.87
Low 2.78
Strict 1.51
None 7.36
High 2.03
Low 6.95
High .18
Low 6.52
Low 9.52
4.41

Source:

Economic Analysis, Appendix D, pages D-35 through D-49.

G. Conclusion

The BEPS program is complex, wide-ranging in impact and likely to be long-term in duration. If rational decisions are to be made, now and in the future, a systematic framework needs to be defined at the outset and continually refined as the program develops. Without such a framework, not only will DOE lack the information necessary to make decisions, but it will fail to generate the support necessary for the effective execution of the program.

The Congress, which is the final legislative authority for the program; the states, which will have to implement it; the building and design industries, which will have to work with it; and consumers, who will ultimately benefit from it, must be convinced, by a thorough body of evidence, that the program is beneficial. Unfortunately, DOE's analysis is so fragmented, incomplete and inconsistent on key points that it fails to inspire confidence.

A conceptual framework, such as the one CECA has proposed, can serve to provide the systematic organization, weighing and presentation of evidence that DOE's research effort so sorely lacks.

CHAPTER XIV

SELECTING A SENSIBLE BEPS SCENARIO

A. Introduction

The previous chapter established a conceptual framework for setting policy in the BEPS program and interpretted the actual circumstances affecting the potential for energy conservation in new buildings in terms of that conceptual framework. CECA has recast DOE's analysis in terms of this framework and has filled in the many gaps left by DOE with our own analyses. We are convinced that very large benefits for the Nation and the Consumer will result from an aggressive BEPS program. The purpose of this chapter is to outline such a program.

B. A Life Cycle Cost Representation of the Potential for Energy Conservation in New Buildings

Let us assume that Figure XIII-8 represents a realistic picture of the life cycle costs of potential energy conservation in the residential buildings sector. The data available for the commercial sector are not as fully developed, but we believe the situation in that sector does not diverge greatly from the residential sector. If anything, the circumstances in the commercial sector would be even more favorable to conservation. Let us briefly review the elements that constitute this reality.

1. The technology exists to conserve vast amounts of energy beyond either common practice or nominal BEPS. DOE's analyses of conventional approaches have shown some of this potential for conservation beyond nominal BEPS. Our analyses of super-insulation, passive solar and super-efficient housing have shown the full potential (see Chapter V and Appendix II).

2. Fuel prices and conservation costs are such that almost all of the technologies are cost-justified at the margin. DOE showed that low infiltration is cost-justified. We have shown that solar and super-insulation are cost-justified as well (see Chapters IV, VI, VII and Appendix I).

3. The social goal of maximum practicable improvement in energy-efficiency has been set by Congress and repeatedly embraced by the Administration. It has also been supported by a series of major national studies (see Chapter II).

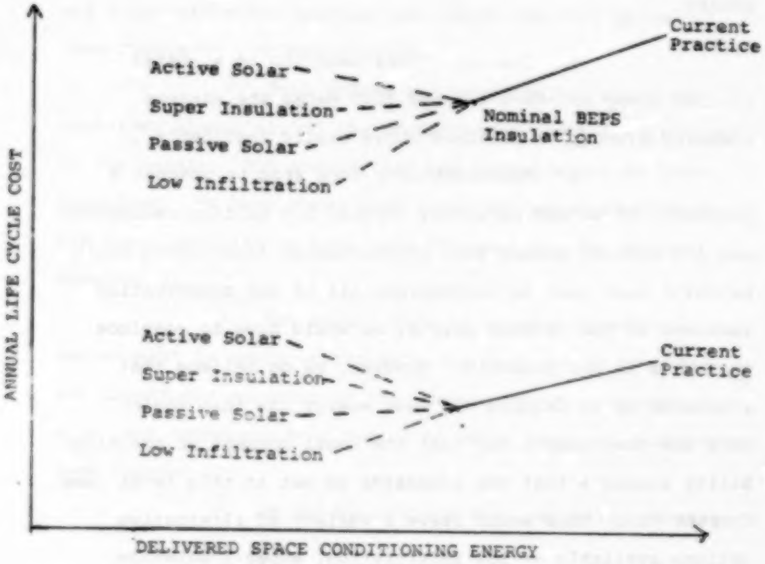
4. We do not believe that weighting factors

and fuel premiums were either required by law, or are necessary to accomplish the goal (see Chapter VIII). The escalation rates of fuel prices have made the difference between LCC optimum points for different fuels small enough so that we can set standards without reference to fuel prices.

5. The LCC curves seem to be situated in such a way and have a shape that makes the minimum inequity principles outlined above easily applicable.

6. Practicability does seem to present a problem. If we ask ourselves whether 1.5 million residences and 1.4 billion square feet of commercial floor space could be built next year to incorporate all of the conservation features of the optimum points, we would have to conclude that this is not possible. However, we do believe that standards which require 30% less energy use than nominal BEPS are practicable and that the legal concept of practicability requires that the standards be set at this level (see Chapter IX). This would leave a variety of alternative options available -- low infiltration, super-insulation, optimum passive solar systems and active solar systems (see Figure XIV-1). Each of these options could be expected

FIGURE XIV-1
THE RELATIVE LIFE CYCLE COST OF OPTIONS TO MEET A STRICT STANDARD



Source:

CECA

to account for a share of the new buildings constructed, thus preventing shortages associated with any one option.

7. The value to the nation of strict standards is clear. The capital investment necessary to achieve these standards is easily cost-justified. The administrative resources necessary to execute the program are relatively fixed, so that the stricter the standards, the higher the return to administrative costs.

8. There are a number of structural imperfections in the market for new buildings which lead us to conclude that rapid improvement in the design energy use characteristics of new buildings will not occur in the absence of regulations (see Chapter III).

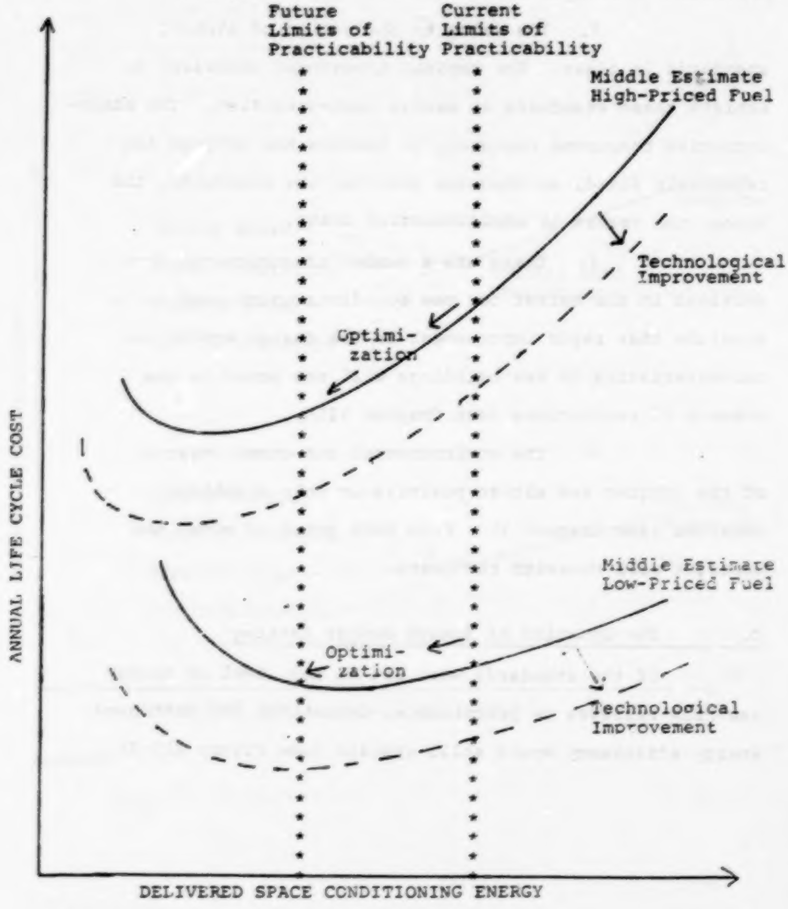
9. The environmental and other impacts of the program are either positive or only slightly negative (see Chapter X). From this point of view, the benefits will outweigh the costs.

C. The Dynamics of Energy Budget Setting

If the standards were set at the level of energy use CECA believes is practicable, incentives for continued energy efficiency would still operate (see Figure XIV-2).

FIGURE XIV-2

THE DYNAMICS OF ENERGY BUDGET SETTING



Source:

CECA

1. If industry and the consumer take the standard as a target, considerable effort beyond current practice will be necessary to achieve the BEPS standard. Furthermore, there would still be an incentive to achieve the level of energy use set by the standard at lower cost, i.e., shifting the LCC curve down and to the left.

2. If industry and the consumer aim for this optimum point (which they have not done in the past), the standards certainly would pose no constraint to continuing improvement in energy efficiency. They would simply guarantee a minimum of conservation.

3. From the consumer's point of view, there would still be an economic incentive to move toward the optimum. Moreover, there would be a range of very cost-effective options available to meet the standard. At least four combinations of conservation options would meet the standard. Each would start with nominal BEPS and add one of the following -- low infiltration; or optimum passive solar; or super insulation + mechanical devices; or active solar systems.

4. With regard to fuel choice, we would expect the consumer to make a rational choice. Our LCC curves incorporate only two costs, capital costs for conservation equipment and fuel costs. On the basis of these two costs, the rational consumer would choose the lower priced fuel.

However, much more than these costs goes into making the decision about which fuel system to use. It is entirely possible that the cost of the equipment or its maintenance could offset the difference we observe between the LCC curves. Furthermore, noneconomic factors, such as convenience or certainty of fuel supply, could enter into consideration.

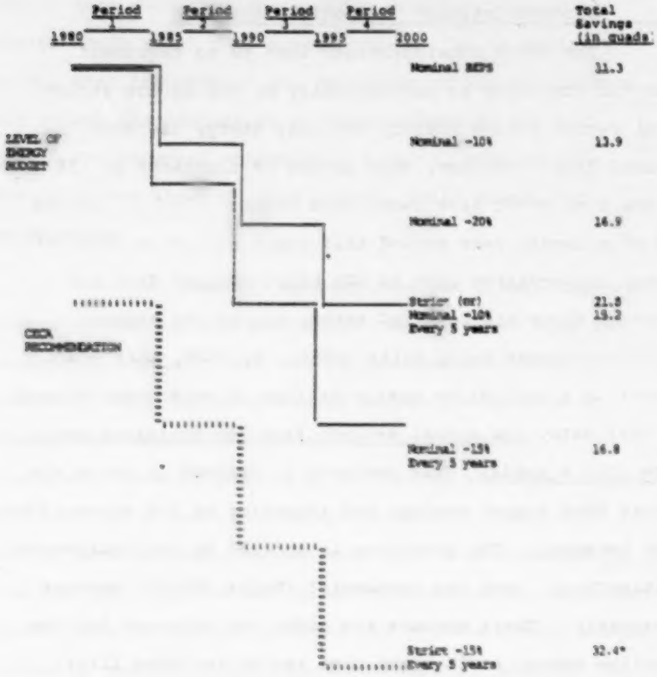
5. Finally, we must consider future improvements in technology and changes in the limits of what is practicable. Options that are at the limits of what is technically feasible today should become practicable in the not-too-distant future and they should become economically more attractive as technology advances. Therefore, the program should systematically lower the level of maximum energy use in lock step with advances in technology and improvements in the practicability situation. Indeed, there is a sense in which the program should ensure progress by setting targets at which industry and the consumer must aim. These should be realistic targets defined by existing technology. Super-efficient houses are already being built; they certainly should be practicable on a broad scale twenty years from today.

D. Recommendations: A Specific Scenario

The above considerations lead us to recommend that the standards be set initially by DOE at the strict level (which allows roughly 30% less energy use than nominal BEPS). Further, they should be tightened by 15% of the base every five years (see Figure XIV-2). At the end of a twenty year period this would achieve a level of energy conservation that is 60% below nominal BEPS and somewhat above the level of energy use in the super-efficient houses being built today. By 2000, this would result in a cumulative energy savings of more than 30 quads. By that date, the annual savings from new buildings would be more than 6 quads. This estimate is derived by using the strict BEPS annual savings and adjusting by 15% at each five year interval. The procedure is applied to the residential (Table XIV-1) and the commercial (Table XIV-2) sectors separately. These numbers are added and adjusted for the baseline energy savings and time lag as in Table III-2.

This scenario of saving 6 quads per year with at least 2.5 attributable to BEPS sets what we believe is the maximum practicable improvement in the buildings sector. It is 25% above the low estimate derived from the national energy studies reviewed in Chapter II and 50% below the high estimate derived from those studies. In

FIGURE XIV-3
BEPS SCENARIOS



OPTIONS TO MEET STRICT - MINUS 15% EVERY 5 YEARS

1. Low Infiltration	Any Option	One Option	One Option	One Option
2. Optimum Passive Solar		plus 70% of a second option	plus 70% of a second option	plus 70% of a second option
3. Super Insulation & Mechanical Options			plus 70% of a third option	plus 70% of a third option
4. Active Solar Heat & Water				plus 70% of a fourth option

Source:
Energy Budget Level Selection, Appendix H, page H-26.

*This number is estimated by the following proportion:

$$\frac{\text{Nominal BEPS -15\%}}{\text{Nominal BEPS}} = \frac{\text{Strict BEPS -15\%}}{\text{Strict BEPS}}$$

TABLE XIV-1

CECA MODEL OF RESIDENTIAL SECTOR ANNUAL ENERGY SAVINGS (in Quads)

Strict BEPS	1985	1990	1995	2000
1980-1985	.22	.22	.22	.22
1985-1990	--	.19	.19	.19
1990-2000	--	--	.16	.16
Total Annual Savings	.22	.41	.57	.69
Strict minus 15% Every 5 years				
Housing Stock 1980-1985	.22	.22	.22	.22
1985-1990	--	.22	.22	.22
1990-1995	--	--	.18	.18
1995-2000	--	--	--	.21
Total Annual Savings	.22	.44	.62	.83

Source:

Based on Economic Analysis, Appendix D, Table D-1, p. D-4.

TABLE XIV-2

CECA MODEL OF COMMERCIAL SECTOR ANNUAL ENERGY SAVINGS
(in Quads)

Strict BEPS	1985	1990	1995	2000
Building Stock				
1980-1985	.27	.27	.27	.27
1985-1990	--	.32	.32	.32
1990-1995	--	--	.26	.26
1995-2000	--	--	--	.21
Total Annual Energy Savings	.27	.59	.85	1.06
Strict BEPS Minus 15% every 5 years				
Building Stock				
1980-1985	.27	.27	.27	.27
1985-1990	--	.37	.37	.37
1990-1995	--	--	.43	.43
1995-2000	--	--	--	.49
Total Annual Energy Savings	.27	.64	1.07	1.56

Source:

Based on Economic Analysis, Appendix D, Table D-2, p. D-36.

fact, the high estimate from the national energy studies seems to us to be too high -- or, put another way, it would demand an extremely aggressive conservation strategy that operated at the limits of technical feasibility. The national studies' high estimate of energy conservation for the buildings sector calls for it to consume roughly one-half the energy it does today. In order to achieve this level of conservation, every new building constructed, starting immediately, would have to be close to the super-efficient house and a very extensive retrofit program plus major advances in appliance efficiency would have to be implemented. This is a technically feasible target, but not an immediately practicable one.

E. Conclusion

We are assured by our own analysis, by our critical reading of DOE's analysis and by our review of the national energy policy studies that the American consumer will benefit economically and that America's energy future will benefit strategically from the maximum amount of conservation in buildings. We are assured, as well, that a great deal of energy can be saved in new buildings.

We, therefore, urge DOE to adopt a forceful and dynamic BEPS program along the lines we have suggested. Neither economic nor technical concerns pose an obstacle to such a program. Rather, the only remaining issue is whether DOE, the Administration, the Congress and the building industry have the will to execute an effective BEPS program.

APPENDICES

APPENDIX I

AN ANALYSIS OF THE PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

A REPORT TO

THE CONSUMER ENERGY COUNCIL OF AMERICA

BY THE

Madison Consulting Group

MARCH 1980

PREPARED BY

CHARLES J. CICCHETTI

ROD SHAUGHNESSY

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Introduction

This analysis of the Building Energy Performance Standards (BEPS) has several purposes. First, the price projections utilized by the Department of Energy (DOE) to develop BEPS will be reviewed using regression analysis and Energy Information Administration data. Second, a life cycle cost program more comprehensive than the one used by DOE, has been developed as part of this study and will be applied to calculate the present value of conservation investments. Sensitivity analysis will be performed in order to address the policy debate surrounding BEPS. Third, the philosophy of BEPS, as well as our review of its critical omissions and deficiencies will be outlined. Finally, policy recommendations and conclusions will be presented.

Part I. Price Projections

A. General Considerations

Three general matters should be addressed before discussing the quantitative comparison of price projections that will be presented in this section. The first matter is consistency. Prices can be projected in "current" or "real" dollars. However, it is absolutely essential that a consistent discount rate and price projection be utilized when performing a life-cycle cost, net present value or benefit/cost analysis.

As we reviewed the BEPS documentation and supporting analysis there were times when it was not clear that this rudimentary principle of quantitative analysis has always been followed.

If the concepts of constant and real dollars are mixed misleading and erroneous conclusions will be drawn. If "real" price increases and "nominal" discount rates are mixed there will be a strong downward bias in the calculation of the number of dollars that can be spent today to save one dollar one year from now. The opposite is true if "nominal" price increases are discounted by "real" discount rates. Since investment decisions to save energy will reduce costs for more than one year in the future, the compounding effect of any inconsistent mixing of real growth rates and nominal discount factors will be numerically very large.

B. Methodology

The second general point that should be considered is the selection of a methodology for making price projections. There are three general methods for making energy price projections. Combinations of the three can increase the number of alternative approaches to price projections.

One method is to develop an econometric model of the entire economy, or a significant part of it, such as the energy sector. Econometric models closely parallel economic theory and estimates of the coefficients of several causal factors are jointly determined. Projections of the future values of the causal, or explanatory variables, are made. (e.g., alternative energy prices, incomes, population, insulation costs, etc.) These in turn are used to estimate the future values of the predicted, or dependent variables - in this case, fuel prices.

The BEPS analysis used Energy Information Administration price projections based upon an econometric model. We do not perform any independent review of that model for purposes of this report. We do, however, make two observations. First, forecasts of energy prices based upon an econometric model are only as good as the specification of the causal factors in the model. Second, forecasts based upon an econometric model are implicitly based upon the assumption that the underlying structure of the economy, and all its interrelationships, will not change over the forecast period. Recent events in energy make this assumption untenable.

A second method used to project prices utilizes time series data. Trend lines, linear or exponential, can be calculated using regression analysis. Greater weight can be given to more recent years, if the analyst believes these are more pertinent to the future. This approach is simpler than an econometric model. However, the forecast may be sensitive to the time period selected for estimation. Forecasts, based upon a time series approach, implicitly assume the future will be like the recent past. This is more likely to be so for short-term forecasting than for longer term forecasting.

The third general method for forecasting, energy consumption is called an end-use or engineering approach. The analyst specifies, somewhat subjectively, what he/she believes the future relationship of energy use and other factors will be (e.g., size of houses, floor space per person, GNP per employee, etc.) Forecasting future energy prices can also be based upon such an engineering approach. Engineering models generally use less statistical estimation and more judgment about the future structure of the market.

Political, regulatory and institutional factors, especially changes in each, can be analyzed to help predict price changes. For example, crude oil decontrol, natural gas deregulation, the financial fallout of the TMI nuclear accident, changes in OPEC, and so forth, will all affect energy prices in the future. These cannot easily be reflected in econometric or trend line analyses of past data because these same events did not occur in the past. However, the engineering/institutional model is based upon such matters. Its principal drawback is that increasing its reality is gained by increasing subjectivity.

We will specifically consider several price projections below. Our intention is to compare price projections used to develop BEPS with price projections that take into account more current energy price trends and fundamental institutional alterations in the energy market place. Unlike the BEPS analysis, we have used trend analysis and have drawn additional inferences from other institutional and market changes in the structure of the energy market, as these changes are likely to affect pricing.

C. Regression Analysis of EIA Data

The third general area to be discussed before examining the quantitative comparisons is related to the one just discussed. Its importance is so great that a separate consideration is justified. Analyzing the trend in "real," or constant, dollar energy price changes over the past several decades yields a surprising degree of stability between the price of energy, especially oil and natural gas, and all other goods and services. (Note: electricity prices generally decline relative to other goods and services.)

There are two notable exceptions. These are related to the 1973-74 Arab oil embargo and the 1979 Iranian revolution. To predict the future pattern of energy prices, one must decide whether these were mere aberrations, or were alternatively indicative of a new price trend due to a revised institutional setting in the energy marketplace. Let us consider figure 1 to understand the importance of these questions.

Trend Line A has a negative slope. It indicates that based upon the Energy Information Administration's data, found in Table 6 of its Annual Report to Congress 1978, Volume 2, there was a decline in the "real" price of domestically produced crude oil from 1960 to 1973. (World prices behaved similarly.) Trend lines B, C and D were estimated using a linear regression of the exponential equation (price = ae^{rt}); "r" is the estimated annual rate of change in price. Through 1978 the data utilized was drawn from the EIA, 1979 data was taken from Chase Manhattan's monthly newsletter, The Petroleum Situation.

Trend Line B shows the effect of considering the 1973-74 embargo along with the historical perspective of the last twenty years. Trend line B is based upon a regression using the 1960 to 1978 period. Real prices declined from '60 to '73, jumped in '74, and were approximately stable or declined from '74 to '78. Treated in this manner, the embargo is considered a statistical aberration.

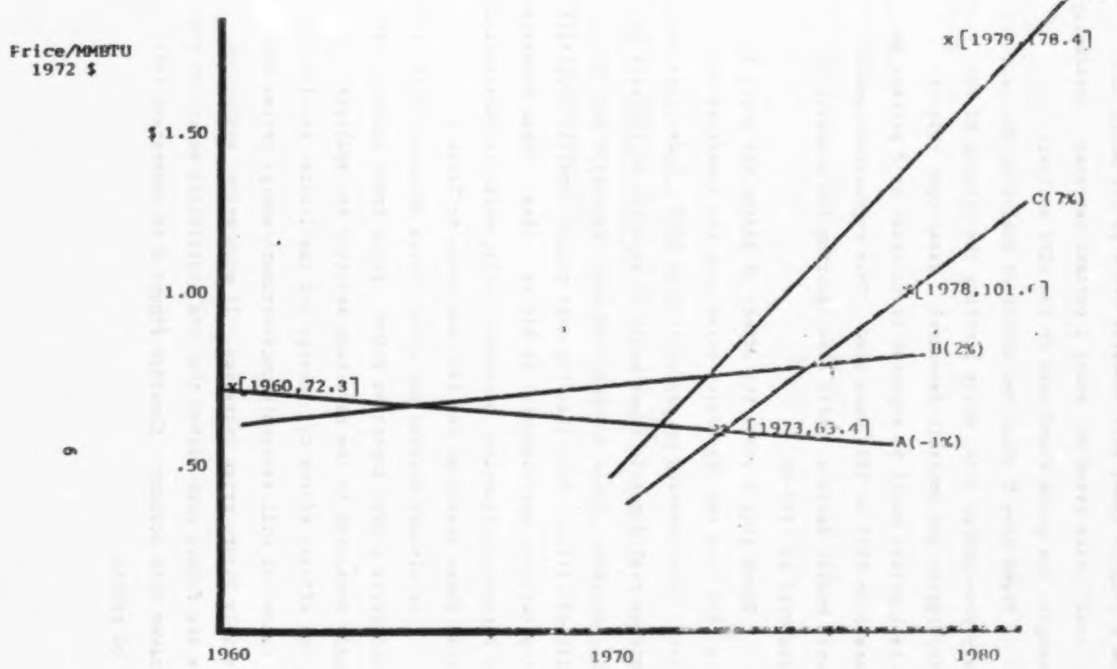

Figure 1
Domestic Crude Price Trends (Real $)

Trend line B roughly shows that domestic crude prices would have a modest "real" price trend of about 2 percent per year. Incidently, this is roughly the price trend used in the BEPS analysis.

Trend line C shows the effect of analyzing the past and immediately pre-embargo data, while ignoring the effects of the Iranian Revolution and domestic decontrol. Based upon this regression real prices would be expected to increase at 7 percent per year. Data from 1973 to 1978 were used. This regression ignores the historic modest decline, while also ignoring the dramatic increases observed in 1979-80.

Trend line D shows the effect of adding the price incremses in 1979 into the regression based upon the immediate pre-embargo data, thus covering the period 1973 to 1979. Under this set of assumptions real domestic crude would be expected to increase at 11 percent per year. Table 1 summarizes each regression and the 1980 predicted prices. Note that the most recent domestic composite crude price (without entitlements) is $16.98. (See: Chase Manhattan Bank, The Petroleum Situation, December, 1979), which is substantially greater than those predicted for 1980 and shown in Table 1.

As already pointed out above, these domestic crude trend lines demonstrate a most important point. Price trend analysis can be extremely sensitive to the data base selected for analysis. Omitting the effects of the Oil Embargo and the Iranian Revolution/domestic decontrol will seriously underestimate energy prices and quite possibly future price increases. If such price explosions are to be the future norm rather than the statistical exception they must be taken into account. Consider figure 2 to understand this last set of points.

Real Price Trends Using EIA Data

Table 1

Crude (domestic) Oil	1960 to 1978	1973 to 1978	1972 to 1979*	1973 to 1979*
Annual Pct. Change (r)	2.3%	7.0%	12.2%	11.1%
1980 Price Estimate				
c per MMBTU	93.4c	$1.22	$1.68	$1.62
$ per barrel	$5.42	$7.08	$9.74	$9.40

---

*1979 estimate comes from Chase Manhattan's October Domestic Price of $2.928 per MMBTU. (The Petroleum Situation, Volume 3, No. 12, December 1979).

A-1 Other data are from the EIA, Table #6, Volume 2, The Annual Report to Congress 1978.

No one knows whether or not the long-term future will be similar to the historic more-or-less flat trend in real energy prices found up to 73 and between the Embargo and Iranian Revolution. BEPS analysis was more or less based upon flat or modest real energy price increases. However, two other alternatives seem possible.

First, because of the phased decontrol of domestic crude oil, real energy prices will increase. In the near term, due to domestic decontrol, trend line B (increasing real energy prices) seems more likely than trend line A (flat or modest growth in real energy prices). But what about the longer term? No one can know with certainty. Synthetic fuel development as a long term strategy would also suggest a continued substantial increase in real domestic energy prices. Nevertheless, absent another world oil shock, the historic pattern cannot be ignored.

The second alternative future is the prospect of yet a third world oil price increase followed by relatively constant real prices, similar to the period following the Arab oil embargo. This could have an effect like trend line C. An era of stepping stones may be the future pattern of real energy prices. Under such a pricing pattern periodic increases in crude oil prices could be expected along with periods of relatively stable energy prices as the real prices of all other goods and services realigned themselves with the last round of crude oil price increases.

It seems unlikely that OPEC would ever let a significant real decline in crude prices occur. The stepping stone basis for future energy prices would be like a ratchet with periodic upswings and readjustments. With domestic decontrol of crude oil and dere-

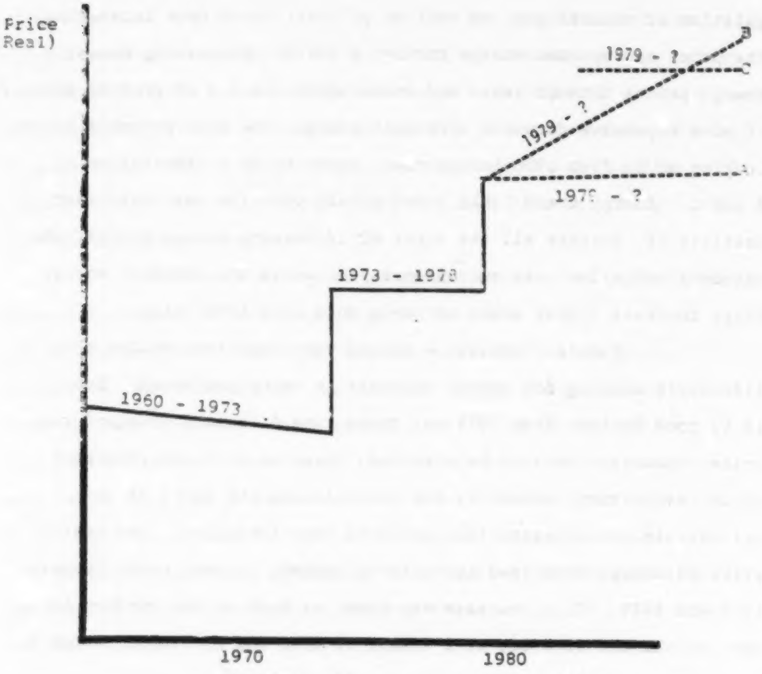

Figure 2

Turning Points in Real Domestic Crude Oil Prices gulation of natural gas, as well as policies based upon increasing the price of imported energy through a tariff, increasing domestic energy prices through taxes and encouraging the use of greater amounts of more expensive domestic synthetic energy, the most probable future, looking at it from 1980 perspective, seems to be a combination of B and C. Energy trend lines based solely upon the past only seem possible if, despite all the signs of increasing energy prices, the nation's inflation rate outdistances the world and domestic energy price increase. This seems unlikely on a long-term basis.

Figure 2 implies a second very important matter when life-cycle costing for energy analysis is being performed. Even, if by good fortune from 1979 on, trend line A (nearly constant real price increases) were to be observed, there is still an important price readjustment necessary for establishing the level of investment in conservation that would be cost justified. The real price of energy increased about fifty percent in real terms between 1978 and 1979. This increase may total as much as one hundred percent by the end of 1980, as a result of OPEC and President Carter's domestic price policy and import tariff adjustments.

The BEPS analysis used 1978 and early 1979 data. The full effect of 1979 and 1980 should be considered. Sensitivity analyses will be performed in a later section to show the importance of adjusting both the growth rate in prices and the initial year's fuel bill for setting the levels of BEPS

D. Comparison of Price Projections

We shall now compare the price projections used by the Department of Energy to analyze BEPS with our price projections, which are more in keeping with recent price trends in the aftermath of the Iranian Revolution, TMI, crude oil decontrol, natural gas deregulation and the Carter Policy of higher domestic energy prices and import tariffs to encourage conservation. Tables 2, 3 and 4 outline the price trends estimated by using a linear regression for an exponential time trend for the years indicated and the BEPS (Residential) real price projections for fuel oil, natural gas and electricity, respectively.

Estimates of real and current dollar fuel prices based upon each regression are also shown in Tables 2, 3 and 4. Data before the earliest year shown was not published by the Energy Information Administration. We decided to use EIA published data from the same document. More recent data, which is consistent with current prices, were calculated as described in the notes to each table in a fairly conservative manner. Both higher rates of growth than those used by BEPS and a higher intercept or initial 1980 price for heating, especially home heating, is indicated by the results of this analysis. Whether these estimates are a more accurate forecast of the future depends upon the decision-makers' view of the matters discussed in the preceding section.

These results are summarized in Table 5, along with the values based on this analysis, which we have selected for the life-cycle sensitivity analysis, which are to be presented below.

Heating Oil Real - Price Trends

Using EIA Data*

Table 2

1975-1978	3.37%	
Price 1981 ¢ per gallon	36.3¢ (real) (68.2¢) (current)[+]	
1975-1980**	11:52%	
Price 1981 ¢ per gallon	53.9¢ (real) ($1.01) (current)	
BEPS (Res)[++] U.S. Average		
1980 to 1985	1.38%	
1985 to 1990	3.28%	Simple Average 2.3%
>1980	2.19%	

---

*Table 30, EIA and price deflaters used by EIA.

**1980 was guessed to be 95¢ per gallon current and 54¢ per gallon real with 12% inflation in 1979 and 1980.

+1981 inflation 12%

++See Park IX, DOE, January 23, 1980, Methodology and Procedures for Life Cycle Cost Analysis.

Natural Gas Real Price Trends

Using EIA Data*

Table 3

1973-1977	8.03%	
1980 Price $ per MCF	$2.06 (real) $3.63 (current)	
1973-1979**	8.64%	
1980 Price $ per MCF	$2.13 (real) $3.75 (current)	
BEPS (Res) U.S. Average		
1980 to 1985	2.27%	
1985 to 1990	2.25%	Simple Average 2.1%
>1990	1.90%	

---

*Table 35, EIA

**1979 current price was estimated to be $3.25 per MCF or 32.5c per therm; inflation in 1979-1980 of 12% per year was used.

Residential Electricity Price Trends

Using EIA Data*

Table 4

1973-1978	4.66%	
1980 Price $ per 500 KWH per month	$16.76 (real) $29.51 (current)	
1973-1979**	5.35%	
1980 Price $ per 500 KWH per month	$17.39 (real) $30.61 (current)	
BEPS (Res) U.S. Average		
1980 to 1985	.75%	
1985 to 1990	.32%	Simple Average .4%
1990	.10%	

---

*EIA table

**Assumes 5¢ per KWH, $3.00 customer charge for current dollar 1979 bill, 12% inflation 1979-1980.

Summary of Real Price Growth Rates
for Residential Consumers

Table 5

	Heating Oil	Natural Gas	Electricity	Sensitivity* Range
Low Trend	3.4%	8.0%	4.7%	3.0%
High Trend	11.5	8.6	5.4	8.0
BEPS Average	2.3	2.1	0.4	0.5
Average of Low & High Trend Minus BEPS Average	5.15	6.2	4.65	5.0

---

*Note the numbers shown in this column are presented to roughly approximate the values shown in the first three columns. They are used below for sensitivity analysis.

PART II. Life Cycle/Cost Sensitivity Analysis and BEPS

A. Alternative Investment Analysis Methods

Two points must be understood. Some investment analyses are based upon life cycle costs, others on net present value and still others are evaluated using benefit-to-cost ratios. A description of the characteristics of each is a useful first step. Matters will be kept simple in this discussion.

Life Cycle Cost Analysis

Life cycle cost analysis has three values to be estimated: (1) the cost to install a heating or conservation system, (2) the quantity of expected energy use, (3) the present value of the stream of unit energy prices. Decisions are based upon selecting the system with the lowest life cycle cost.

In symbols:

$$(1)\ LCC_i = I_i + Q_i \left(P_i \sum_{t=0}^{N} \frac{(1 + a_i)^t}{(1 + r)^t}\right)$$

$$\text{let } F_i = P_i \sum_{t=0}^{N} \frac{(1 + a_i)^t}{(1 + r)^t}$$

Then $LCC_i = I_i + Q_i F_i$

Where:

LCC_i = Life cycle cost (i)

I_i = Investment type (i)

Q_i = Quantity of fuel used per year.

P_i = Unit price of fuel in initial year

a_i = Annual increase in fuel price
r = Discount rate
t = Year
N = Life of investment

Consumers will maximize their benefits by selecting the lowest possible LCC_i.

Net Present Value

Net Present Value (NPV) analysis is based upon subtracting costs from the estimated benefits. Benefits equal the present value in the savings in fuel used, operating costs saved and any capital cost savings, when a new system is added to, replaces or substitutes for an existing or alternative system. Costs equal the life cycle costs of the new system. (Note: that if the "new" system is insulation the fuel component of the life cycle cost is omitted, since the fuel savings is reflected in the benefit calculation.)

Consumers should select only those investments which have positive NPV and the optimal choice is when Benefits minus Cost is maximized. In symbols:

$$(2) \quad NPV_i = \sum_{t=0}^{N} \frac{b_i(1+g)^t}{(1+r)} - LCC_i$$

$$\text{If } B_i = \sum_{t=0}^{N} \frac{b_i(1+g)^t}{(1+r)^t}$$

Where b_i = is the initial year's benefit (e.g., value of the energy saving in dollars)

g = annual growth in vlaue of energy saving

NPV_i = the net present value of benefits minus costs

Cost-Benefit Analysis

Traditional benefit-to-cost ratio (B/C) can also be used to consider heating, cooling, and conservation investments. In symbols:

$$(3) \quad \frac{B}{C} = \frac{B_i}{LCC_i}$$

Consumers should reject any investment in which this ratio is less than one. Any of the three methods can be used to make energy saving investment decisions. In all three forms of investment analysis LCC plays an important role. Thus we have performed a sensitivity analysis of LCC in a later section. If we find conditions in which LCC has been understated in the development of BEPS, the policy conclusion for all three methods is the same. Additional benefits to offset an increasing life cycle cost must be sought. In the cases at hand additional benefits mean more energy savings. This conclusion is obvious for NPV and B/C analysis. The former requires $NPV > 0$ and the latter that $B/C > 1$. Hence if C (LCC) increases, one must attempt to raise B.

An additional consideration in LCC analysis is the effect of changing energy prices on investment levels. As energy prices increase, greater investment in energy conservation becomes cost justified. Therefore, energy use (saving) declines (increases) as investment in conservation increases. Expressed mathematically, suppose there was some continuous LCC function and it depended on Q, the quantity of energy used. In symbols:

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(4) $LCC(Q) = I(Q) + PQ$

Where:

$LCC(Q)$ = a continuous function of Q

$I(Q)$ = an investment function for conservation, in which as I increases (the investment), Q decreases (energy use)

P = the present value of the growth in unit prices for energy times the current unit price

Q = annual energy use

Consumers will want to pick the lowest possible LCC. To minimize the simplified LCC specified in (4), its derivative is taken with respect to Q and set equal to zero.

$$(5) \quad \frac{dLCC}{dQ} = \frac{dI}{dQ} + P = 0$$

$$(5') \quad \frac{dI}{dQ} = -P$$

Note that: $\frac{dI}{dQ} < 0$, and that it is the negative inverse of the marginal cost of conservation. $\frac{dI}{dQ}$ indicates the effect of spending more on conservation investments (I) will reduce the annual consumption of energy (Q). (It is also the inverse of the marginal cost of energy use.)

To minimize LCC from (5') we conclude that as P increases, more conservation (that is less Q) is suggested. But as Q declines, more I is necessary, since $\frac{dI}{dQ} < 0$. To revise BEPS, if our sensitivity and price projections suggest a higher P, we conclude that more energy saving investments will be required, (I). However, we do not know the relationship of dI and dQ, only the fact that it is negative. Three cases should be considered: 1) the relationship is constant (proportionate).; 2) spending more money on I has a more proportionate effect on reducing Q; or 3) spending more on I has a less than proportionate effect on reducing Q. These three cases and their policy implication are as follows:

Reductions in Q as I Increases	Policy
More than proportionate	$\Delta I > \Delta P$
Proportionate	$\Delta I = \Delta P$
Less than proportionate	$\Delta I < \Delta P$

In summary, more energy conservation is suggested, regardless of the method of analysis LCC, NPV, or B/C for any finding in which initial year energy prices, or their rate of increase, has been understated. Higher energy prices lead to an increase in the energy cost component of life cycle cost, and this means that more money should be spent to cut energy use. At an optimal life cycle cost or net present value, we can assume the consumer is indifferent between spending an additional dollar to save energy and paying the present equivalent of one dollar more for fuel over the life of the energy saving investment. Consider an initial optimal point, which has such indifference. If a constant energy-saving-to-conservation-dollar-invested relationship is present in a particular climate (the proportionate case), then when fuel prices increase, the amount invested to conserve will equal the fuel cost increase. The amount spent will exceed the fuel price increase if investors expect an increasing energy-saving-per-dollar-invested relationship. The amount spent will be less than the fuel price increase if investors expect a diminishing energy-saving-per-dollar-invested relationship.

If BEPS was formulated omitting consideration of some inexpensive energy saving investments, as I increases, Q will decrease more rapidly, i.e. Q's reduction will be more than proportionate to an increase in I. This suggests that for small increases in ΔP, more than proportionate ΔI would follow. Undoubtedly diminishing returns will set in, and the relationship between increased I and decreased Q will become constant or less than proportionate.

B. Selecting LCC Analysis Methodology

The second point to consider is whether to use simple life cycle cost analysis or a more complex one. Since the purpose of this discussion is the setting of building codes, some additional complexities seem warranted. Buildings are not generally purchased with cash on hand, nor can their maintenance be ignored. Instead, mortgages are typically incurred. Some amount is used as down payment. Property taxes based upon a changing assessed value are paid. Maintenance is required. Personal income tax deductions for interest and property taxes are granted. Additionally, financial and economic (useful) life may vary in length. To heat and/or cool a home more than one energy source may be required at different initial prices, with different annual percentage increases.

Since building cost and operating conditions are likely to vary considerably, we have opted for a life cycle cost model which includes such complexities. If NPV or B/C analyses were utilized, such complexities could be included, but the increased complexity in each equation would be even greater, since both benefit and cost components might be affected. Residential building codes are, in our judgment, better analyzed using the things that residential consumers think are important: initial costs, monthly payments, tax (property and income) considerations, and monthly utility and fuel bills.

Analyzing life cycle costs raises yet another issue. An analysis of social benefits and costs might treat tax preferences for home ownership and mortgage payments as transfer payments. Furthermore, differences between mortgage interest rates and social discount rates would probably be ignored. However, if we are attempting to determine an appropriate level of building codes for consumers, differences between mortgage rates and a given consumer's discount rate should not be ignored. (If we assume the existing tax advantages of home ownership in the United States are intended to achieve a particular social purpose, social benefit-to-cost analysis should also include these factors.)

Similarly, the effect of variations in the marginal income tax bracket on personal taxes should not be ignored. Investing in homes is beneficial for tax purposes to homeowners, while paying for fuel is not. Interestingly, while our principal analysis concerns residential building codes, industrial users of energy in the United States receive approximately the opposite tax signal. Fuel use can produce tax benefits, while energy saving investments must be depreciated over time, thus spreading their tax benefits into the future.

The analysis performed in this study is based upon a model that includes the above-mentioned factors. It is detailed in Appendix A, and for ease of use in the field, it has been adapted to a programmable calculator. A final step in the analysis is that we have analyzed most cases using both nominal and real price changes. The reason is straightforward. Consistency requires that only real, or only nominal prices be used as comparison. When mortgages and marginal tax brackets are considered, nominal calculations are more typical. However, prices are generally forecast using real, rather than current dollars. To avoid confusion, and to avoid any doubt that the sensitivity or policy conclusions depend upon the nominal versus real choice, both analyses are performed. We have used a twelve percent (12%) annual rate of inflation to move from one set to the other. To the extent that current inflation is greater than 12%, the nominal case tends to be understated relative to the real case, and vice versa.

C. Quantitative Comparisons

Several sensitivity analyses have been performed around the basic case. We have not attempted to duplicate the BEPS cases. Instead we have decided to perform a sensitivity analysis around our Base Case in order to draw general conclusions about BEPS. Policy directions and conclusions are best understood by minimizing the number of cases considered.

The sensitivity analyses show that either by varying the initial level of energy costs while holding the growth rate constant, or by varying the energy price growth rate while holding initial energy costs constant, the life cycle cost will vary tremendously. Thus, if the recent escalation in energy prices is adequately taken into account, it is clear from this analysis that greater investments in energy conservation can be cost justified in BEPS.

Table 6 presents the base case in both real and nominal terms. In the base case the percent down for the cost of heating, cooling and insulation equals 15 percent (d). The initial investment equals $5,000 (C). Mortgages are based on a 30 year life. In nominal terms mortgage rates (n) are set at 13 percent, and if inflation is 12 percent the corresponding real mortgage rate equals 1 percent. Economic life (L) is set to equal the mortgage life in the base case. Discount rates (i) are set to equal 17 percent and 5 percent for the nominal and real cases.

Annual maintenance (M), primary fuel (fo) and secondary fuel costs (fa) are set equal to $100, $1,000 and $50 resepctively in the base case. Annual changes in each equal 13 percent, 15 percent (fo) and 15 percent (fa) respectively for the nominal case, and 1 percent, 3 percent and 3 percent in the real case. Marginal personal income tax (t) is set equal to 30 percent, and property tax (p) is set equal to 1.5 percent. The assessed value (A) of the energy conditioning and conservation system is set equal to the initial investment cost (C). In the base case this is $5,000. It is not expected to increase in the base case other than by a rate of change (a) equal to inflation.

The present value of the Life Cycle Costs in the nominal base case for the above values is $30,575.00. The comparable real case life Cycle Cost equals $29,966.01.

Energy Prices

As Part I above indicates, rates of increase in energy prices and the initial year's annual energy cost are potentially major points of contention in the establishment of BEPS. Between the time at which BEPS economic analysis was performed (early 1979 data) and the present, energy prices have dramatically increased in real and nominal terms. Energy Users News recently concluded:

> Fuel and power users confronted an overall price mix that was fifty percent above the year-earlier level.

The first sensitivity analysis performed considered such variations in annual rates of growth in energy prices and the initial year's price level. Table 7 summarizes the results for both nominal and real price levels and changes. Three points should be noted. First, when consistent price escalation rates and discount rates are selected there is virtually no significant difference between the real cases and comparable nominal cases.

Second, compare the base case to cases A and B. Holding all factors constant except the price escalation in fuel, real life cycle cost estimates vary from $24,000; $30,000; and $53,000. The average BEPS forecasts of price were generally (recall Table 5) 5% less than the mid-range of our trend line projections. Comparing case B and the base case, which differ by 5% in real terms, life cycle costs vary by $23,000 or roughly 75%.

BASE COST FOR LIFE CYCLE COST
ANALYSIS (NOMINAL AND REAL)

TABLE 6

Variable	Symbol	Nominal Value	Real Value	Partial Solution NOMINAL	 REAL
				d X C	
Percent Down	d	15%	15%	$750	$750
Initial Cost	c	$5,000	$5,000		
				Present Value Mortgage Payments	
Mortgage Rate	r	13%	1%		
Mortgage Life	N	30 yr	30 yr	$3,305.24	$2,531.53
DISCOUNT Rate	i	17%	5%		
Economic Life	L	30 yr	30 yr		
				Present Value Maintenance Costs	
Annaul Maintenance	M	$100	$100		
Annual Change in M	m	13%	1%	$1,894.84	$1,806.36
				Present Value Primary Fuel Cost	
Annual Primary Fuel	Fo	$1,000	$1,000		
Annual Change in Fo	fo	15%	3%	$23,624.92	$23,015.28
				Present Value Secondary Fuel Cost	
Annual Secondary Fuel	Fa	$50	$50		
Annual Change in Fa	fa	15%	3%	$1,181.25	$1,150.76
Marginal Income Tax Rate	t	30%	30%	Present Value of Property Tax	
Property Taxes	p	1.5%	1.5%	$897.11	$847.41
Assessed Value	A	$5,000	$5,000	Present Value of Income Tax Expense	
Annual Change in A	a	12%	0%	-$1,077.74	-$135.23
TOTAL LIFE CYCLE COSTS		==	Present Value Totals=	$30,575.00	$29,966.01

SENSITIVITY ANALYSIS OF INITIAL YEAR'S FUEL COST AND ENERGY PRICE ESCALATIONS (REAL AND NOMINAL)

TABLE 7

Case	Real Variable		Real LCC	Nominal Variables		Nominal LCC
	Fo	fo		Fo	fo	
Base	$1,000	3%	$29,966.01	$1,000	15%	$30,575.61
A	$1,000	.5%	$24,013.89	$1,000	12.5%	$24,934.41
B	$1,000	8%	$53,440.25	$1,000	20%	$51,304.64
C	$ 500	3%	$18,458.37	$ 500	15%	$18,763.16
D	$1,500	3%	$41,473.64	$1,500	15%	$42,388.07
E	$1,500	8%	$76,685.00	$1,500	20%	$73,481.61
F*	$1,500	8%		$1,500	20%	
	Fa=	fa=	$79,020.95	Fa=	fa=	$75,626.01
	$ 75	8%		$ 75	20%	

*The base case Fa=$50.; real fa=3%; nominal fa 15%

Consider, a consumer initially indifferent between investing more to save energy versus spending more for fuel over the useful life of the investment. Additionally suppose the consumer expected each additional dollar of energy saving investment would continue to result in a constant (proportionate) reduction in energy use. Such a consumer would be willing to spend up to the full amount of any fuel price increase to save additional energy.

Residential home ownership, in contrast to energy payments, is subsidized in the U.S. by the personal income tax system. Additionally, property taxes are increased when home investments increase. However, these taxes are also deducted from income when computing personal income taxes.

For a 5 percent difference in the rate of growth of energy prices the increase in the present value of fuel cost over 30 years equals $23,000 (Case B minus the base case). When the mortgage, income and property tax adjustments are calculated an additional after tax investment of $23,000 could be made by the consumer. Note that a pre-tax investment of about $30,000 equals the after tax present equivalent of $23,000 (for the base case tax rates).

Assume the consumer starts with an initial point of indifference, i.e., an optimal life cycle cost home. In the base case this means a $5,000 equipment investment for heating, cooling, hot water, insulation, storm windows, storm doors, and other weatherization and $1,000 in initial annual fuel and/or utility bills. Assume further that the consumer, although it is unlikely for large increases in investment, expects each additional dollar invested in energy conservation will continue to result in equal energy savings per dollar invested (the proportionate case). It follows that the consumer would spend $30,000 more before taxes than the current $5,000 for heating, cooling and constructing his/her home. It remains to be seen how sensitive this value is to the discount rate, initial investment in heating/cooling/construction and initial fuel bill assumptions. We shall review each of these after considering another example of variation in price escalation.

Consider Case A versus the base case. The life cycle cost difference is $6,000, and the real price growth rate difference is 2.5% per year. When all other adjustments in mortgage, income tax and property tax are considered, a pre-tax conservation investment of $8,000 ($7,800) equals an after tax energy investment of $6,000.

Pre-tax investments of $30,000 more at a real energy price growth difference of 5 percent per year or $8,000 at a real energy price growth difference of 2.5 percent per year would mean that the conservation investment increase could more than match the fuel cost increase. Spending such sums in addition to the initially-assumed heating/cooling/insulation costs of $5,000 will result in more conservation and less energy use although not necessarily in a proportionate relationship. The amount of money presumed to be justified using price projections based upon the pre-Iranian Revolution, pre-domestic decontrol and pre-import tariff policies will be too low. Assume that BEPS was based upon an initial indifference between investing an extra dollar for fuel or an extra dollar for conservation (an optimal case). If one expects a proportionate conservation relationship to energy savings investment, this means the BEPS' investment standards could be understated by one hundred fifty to seven hundred percent based upon the sensitivity comparisons just considered.

Before reaching conclusions, however, other sensitivity comparisons should be made. First, returning to Table 7 recall that we stated that rather than continuously higher real energy price growth rates in the future, the events of 1979 and 1980 may mean a higher initial year's energy price (intercept) followed by a long running period in which real prices may be more or less flat, somewhat as contemplated by the BEPS analysis.

To examine this possible scenario consider cases C and D along with the Base Case. Holding growth rates constant across cases, but varying the initial year's fuel cost from $500, $1,000, to $1,500, life cycle costs vary from about $18,500 to $30,000 to $41,500. For each $500 of difference in initial year's fuel cost, life cycle costs increase by about $11,500. After all tax adjustments for mortgages and property an $11,500 increase in fuel cost equals about $15,000 pre-tax investments for heating/cooling/and insulation costs.

Before considering other factors the tentative policy conclusion is that significantly more could be spent on BEPS. This conclusion is drawn from the 1979 and 1980 price increases, which have not been fully reflected in BEPS. Such price increases have affected the initial year's fuel cost and indicate that future real energy prices will be greater.

When both factors are considered, case E versus the Base Case, the life cycle cost difference due to fuel equals about $46,500. After adjusting for tax preferences it equals about $60,500 pre-tax. Calculations made using the consistent comparable nominal case yield nearly identical numerical results.

Discount Rates

The next sensitivity analysis was made on the discount rate and economic life of the investment. These comparisons are found in Table 8. As previously reported there are no significant differences between the real and nominal life cycle cost calculations. Changing the estimated economic life by 10 years means the life cycle cost changes by about $6,500. Note, however, that this calculation is misleading. Most of the difference (about eighty percent) is due to the present value of the fuel use over the different economic life. The remaining pre-tax investment equivalent from the change in useful life of 10 years equals about $1,500. Compared to the initial investment of $5,000, it is not insignificant.

We conclude that if the useful life of conservation investments is increased by a decade, the present.equivalent of $1,500 of future price increases could be offset and consumers would consider spending more initially. Since most residences last longer than their mortgages this extended life would justify more insulation and structural changes than would be found if the analyst set the useful life equal to the mortgage period. On the

SENSITIVITY ANALYSIS OF THE DISCOUNT RATE AND INVESTMENT'S ECONOMIC LIFE

(REAL AND NOMINAL)

TABLE 8

Case	Real Variable		Real LCC	Nominal Variable		Nominal LCC
	i	L		i	L	
Base	5%	30 yr	$29,966.01	17%	30 yr	$30,575.61
G	5%	20 yr	$22,852.17	17%	20 yr	$23,074.81
H	5%	40 yr	$35,744.31	17%	40 yr	$36,794.97
I	3%	30 yr	$38,669.93	15%	30 yr	$38,245.76
J	7%	30 yr	$23,971.57	19%	30 yr	$25,075.27

other hand, heating/cooling systems may have a lesser life than mortgages. This would lead to a reduction in justification for spending additional money for those portions of construction and space conditioning with a useful life less than the mortgage.

From a policy standpoint, the most significant finding in Table 8 is the comparison of cases I and J with the Base Case. Holding all other factors constant and varying the real discount rate from 3% to 5%, to 7% (cases I, Base and J) results in life cycle cost estimates of approximately $38,500; $30,000 and $24,000 respectively. Increasing the discount rate by 2% in real terms results in an approximately 25 to 30 percent reduction in the life cycle cost estimates. (Comparable reductions are found in the nominal case.)

If the discount rates selected for the base cases are too high, 5 percent and 17 percent respectively for the real and nominal case, then more could be spent on investments in BEPS. At a 2 percent lower discount rate after adjusting for the tax treatment of mortgages and property, about $11,000 more could be invested and life cycle costs would be equal to those estimated at the higher discount rate. For smaller reductions in discount rates there is a smaller proportionate reduction in equivalent investment increases and vice versa for larger discount rate reductions.

If the discount rate is too low in the base case less could be invested to achieve an equivalent life cycle cost. For a 2 percent higher discount rate about $8,000 less could be invested to yield the same life cycle costs, after adjusting for taxes. Note, however, that further considerations are required. If less is invested to save energy, annual energy use will increase, and vice versa.

Three other sensitivity analyses of life cycle costs were performed for both the real and nominal cases. Changing the mortgage terms (interest and time) for the heating/cooling and insulation investment did not change results significantly. Mortgage rates 2 percent more and 2 percent less were considered, along with a payment period of 10 versus 30 years. The variation case by case in life cycle cost from the base case and each other case was usually about $500 to $1,000 for both real and nominal cases.

Changing income and property tax was also considered. Ranges from 1% to 2.5% for property taxes, and 20% to 50% for income taxes were considered. Differentials from the base case were typically measured in the hundreds of dollars.

Changing the initial investment cost was also considered. The results were not surprising. Keeping down payment percentages constant each dollar of increase in initial investment adds about 80¢ to the life cycle cost.

In summary, based on the above sensitivity analysis, the three most significant factors to consider in establishing a national BEPS are: (1) the rate of escalation in fuel prices; (2) the initial year's fuel bill; and, (3) the discount rate. Table 8 summarizes the previous discussion. The sensitivity of life cycle cost estimates to these three most "important" factors is shown.

The most difficult question is the selection of a proper discount rate. Some argue that a 10 percent rate should be used. It is not clear whether such arguments for a ten percent rate are in nominal, real or some combination of the two. If, when using a 10 percent rate, it is expected that long-term inflation is 3 percent, the real rate of discount is 7 percent. Selecting a 7 percent real discount rate is equivalent to the adjustment shown in line (d) of Table 9. Life cycle costs will decline by about $8,000.

Increasing the initial fuel and utility bill by $500 (50%) would have almost twice the offsetting effect as a 2 percent real discount rate increase. Increasing real energy prices by 2.5 percent would approximately offset a 2 percent discount rate increase. Increasing real energy prices by 5 percent would have almost four times the offsetting effect. Combinations of such price growth rate and initial year fuel bill increases would always exceed a 7 percent real discount rate. Even a 10 percent "real" discount rate would fall short of the combinations of the fuel price increase and initial year bill increase shown in Table 9 by roughly $3,000 and $25,000, for columns i and ii respectively.

As a final consideration, suppose we take as a given that the discount rate used in formulating BEPS is appropriate. Then, if one concludes in the BEPS analysis that the initial year's fuel and utility cost was understated, and/or the growth rate in energy prices used is too low, there is not any negative offset to the conclusion that considerably more money could be added during construction for investments to save energy.

SUMMARY OF CHANGES IN INITIAL INVESTMENTS: ASSUMES INITIAL OPTIMISM, THE PROPORTIONATE ENERGY SAVING CASE, MORTGAGE AND TAX ADJUSTMENTS

TABLE 9

Relevant Base Case Assumptions:

$5,000 = Initial Investment for Cooling, Heating and Construction

5% = Real Discount Rate; 17% = Nominal Discount Rate

$1,050 = Annual Initial fuel and utility bills

3% = Real increase in fuel prices; 15% = Nominal increase in fuel prices

Factors Varied		Approximate Additional Investments (Pre-tax) Justified for Saving Energy (i)	(ii)
Fuel Price Increases 2.5%	(a)	$ 8,000	
Fuel Price Increases 5%	(b)		$30,000
Initial Fuel Bill Increases $500 (50%)	(c)	$15,000	$15,000
Discount Rate Increased 2%	(d)	-$ 8,000	-$ 8,000
Discount Rate Decreased 2%	(e)	$11,000	$11,000
Sum a + c + d		$15,000	
Sum b + c + d			$37,000

The conclusion of the price projection and sensitivity analysis is that life cycle costs have significantly increased in 1980 as fuel prices have increased. The expectation for the future is for further increases above inflation and above those used to develop the initial BEPS. As the fuel cost component rises in a life cycle cost the investment in the energy saving component should be increased to help offset, and perhaps eliminate the fuel cost increase.

Tax treatment for mortgages and property tax has an additional positive effect that encourages energy saving investments. If mortgage rates are significantly lower than inflation plus the consumer's real discount rate, this also stimulates investment in energy savings. Only when real rates of discount rise above 10 percent will this negative effect begin to offset the positive effect of a 2.5 percent increase in real energy price growth rates and a $500 increase in the initial year's fuel and utility costs. (Note that with a 10 percent real discount rate and 12% inflation the nominal discount rate would equal 22 percent, and with 18 percent inflation the nominal discount rate would equal 28 percent.)

As a result of the life cycle cost sensitivity analysis based upon higher energy price projections, it seems evident that considerably more money could be spent in the 1980's and beyond to build more energy efficient houses. Even homes with active solar systems begin to look cost effective under some not unreasonable scenarios that we have evaluated. However, while spending more money to save energy appears well justified from this analysis, its energy saving cost effectiveness must be measured against what BEPS has already required and what has been omitted. Further, the decisionmaker's judgment about the future state of energy prices and real discount rates must be established. To the specifics of BEPS, we now turn to Part III.

PART III.

SHORTCOMINGS OF BEPS

The BEPS standards, as currently proposed, go a long way toward reducing the bias held by the construction industry and its customers which emphasizes the lowest first costs when designing a home or other building. This bias has resulted in our current building stock, one which is a monument to the cheap energy days of the past and which is causing us to conduct a massive retrofit program to fix up these wasteful structures. While BEPS, as proposed, will improve structural thermal performance in many instances, it does not even match current building practice in some others. Additionally, it leaves out of new construction requirements many of the very conservation steps which DOE and others are recommending as retrofit measures for existing structures.

In other words, BEPS is generally a good attempt by DOE to upgrade current building practices. It is not a perfect effort, and does not in every case result in more energy savings than current practice. We offer our comments not as an attempt to block the implementation of some version of BEPS. Rather, we would like to see the currently proposed BEPS modified to consider the additional conservation steps which we find to be economic using conservative fuel price escalation projections. Although we are aware of a number of problems with BEPS in the commercial building area, we focused our resources on the one and two family housing standards.

A. Prescriptive Vs. Performance Standards

The Energy Conservation Standards for the New Buildings Act of 1976 and its definition of standards is taken by the DOE to mean that standards of a prescriptive nature may not be promulgated by DOE. The definition of standards used in the ACT is fairly clear in this regard, but it is written based on the assumption that the standards will be restricted to being either prescriptive or performance oriented. In fact, there is no reason for the BEPS to be limited to either type.

For the home building market especially, the standards should be as straightforward and inexpensive to implement as is possible. A large number of homes are built each year by builders who have no training in or familiarity with performance-oriented codes. For these kinds of individuals a prescriptive code is much more appropriate than a performance code. They want to be told how to build the house, i.e., what components must they buy and install to meet the code. They do not, and in many cases cannot, calculate the thermal characteristics of the houses they are building. If they are required to perform these kinds of calculations, they will be forced to hire someone to do this. These added costs will be borne by the home buyer. The DOE has determined the combination of components which may be used to comply with the performance standards. In order to simplify things and keep costs as low as possible for home builders and buyers, DOE should publish these combinations as prescriptive standards with performance standards an available alternative.

The Congressional intent in banning prescriptive standards is reasonably clear. Congress wanted to prevent the DOE from establishing one set of "methods, materials, and processes" to be used in all cases of construction. A flatly stated prescriptive code might violate this prohibition. A prescriptive standard, which would be equivalent in energy savings to an optional performance standard to be selected at the discretion of the building designer or builder, would not violate the Congressional wording or its intent. Builders who opt for simplicity may use the prescriptive standards. Those who want to be creative may use the performance standards. Such a standard, with both prescriptive and performance options, would eliminate the extra design and enforcement expense inherent in performance standards.

B. Comparison With Other Standards

1. Residential Conservation Service

The DOE is in the process of working with the states to develop "state plans" for implementation of the Residential Conservation Service Program (RCS). The RCS program is being developed pursuant to Title II, Part I of the National Energy Conservation Policy Act (NECPA) (P.L. 95-619). This program requires that gas and electric utilities with sales above a stated amount encourage the installation of energy conservation measures, including those involving renewable resources, in existing homes owned by utility customers. Other home heating fuel suppliers will also be eligible to participate in the program and may be included in the "state plans".

The Office of Conservation and Solar Energy within DOE, along with its responsibility for BEPS, is operating the RCS program. Items included in the RCS program have been evaluated by DOE for cost effectiveness, and will be recommended to homeowners as steps which they may take to conserve energy and save money.

The RCS program requires the inclusion of certain measures which we feel should also be included as minimum threshold requirements in BEPS. Common sense alone would indicate that if the measures are cost effective in retrofit situations, they must be at least as cost effective when new construction is taking place. The RCS program, in Appendix I to Part 456, Section (c), requires, among other measures, the following for all building categories in all states and climate zones: (1) caulking and weatherstripping (2) water heater insulation (3) clock thermostats (4) pilotless gas ignition systems for furnaces (5) vent dampers for gas furnaces. Additionally, depending upon the climatic zone in which homes are located, vapor barriers are required in ceilings, walls, and floors. The RCS program, to prevent moisture problems, also requires that adequate ventilation be provided above insulation placed in attics and ceilings.

2. Farmers Home Administration, Department of Agriculture

The Farmers Home Administration (FmHA) made a determination in 1977 (see 42 FR 56444) that the Department of Housing and Urban Development (HUD) Minimum Property Standards (MPS), which FmHA had up to that point found acceptable building requirements for making loans, were no longer sufficient to "provide adequate protection for the FmHA borrower or security for the interest of the government."

Using standard analytical methods developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), FmHA adopted its own standards for use in its Rural Housing Loan Programs. These FmHA standards were then used to replace portions of the HUD Minimum Property Standards when determining eligibility criteria for all single family and multifamily dwelling units to be constructed or purchased with Rural Housing loan and grant funds.

The FmHA standards, while requiring heavier insulation than did the HUD MPS, also required a number of additional energy conservation measures, none of which have received adequate attention in the nominal case proposed by DOE for the BEPS program. In fact, the FmHA standards more closely approximate the case which DOE has described as "strict".

FmHA requires: (1) continuous and sealed vapor barriers (2) combustion air from outside the conditioned space be provided for gas and oil furnaces unless the furnace is not located in a conditioned space, and, (3) all openings or joints in the building envelope must be "caulked, gasketed, weatherstripped, or otherwise sealed".

C. Affect of BEPS on the Building Industry

Implicit in the economic analysis done by DOE is the notion that the current depressed situation in the building industry will be made even worse by having very strict energy conservation standards. We reject this notion.

The current dismal situation faced by the building industry is not one which will be affected by a few hundred dollars difference in first costs to meet new (or stricter) energy conservation standards. The building industry is traditionally subject to large cyclical swings in both upward and downward directions. The current depression in building activity appears to be most largely driven by a lack of lending capital available to potential buyers of homes, apartments and commercial and industrial structures. Once this situation, which is related to the overall health of the economy, is reversed, the relatively small additional first costs related to the BEPS program will result in little if any reductions in new construction starts.

Furthermore, one must not assume that the lending institutions are irrational. Interest rates are a function of risk. With lower energy costs resulting from the adoption of BEPS, the ability of borrowers to repay loans will be increased. Increased first costs and the resulting increase in monthly mortgage payments should be more than offset by the reduced energy costs. The net cash benefit of the BEPS becomes even more pronounced during later years of the mortgage as the size of the payments remains constant while energy costs (and thus the cash savings for the energy not used) increase with inflation and other factors.

Risk to lenders will also be reduced for another reason. Buildings constructed subsequent to BEPS will be in greater demand as used buildings than will buildings constructed before the implementation of BEPS. Because of this demand, the risk of loss associated with liquidation of a building in the event of a mortgage loan default is reduced.

The overall net effects of the reduced energy costs and reduced risks associated with buildings constructed in accordance with BPES may very well offset completely any negative effects on building starts which might be anticipated because of the higher first costs and the associated higher mortgage payments. This conclusion can be made with at least as much confidence as the one being made by construction industry representatives that BEPS will have a chilling effect on new construction.

D. Ventilation Rates

One of the reasons used by DOE for not adopting the "strict" case is that this case would have strong negative effects on indoor air pollution. To avoid this effect in the "strict" case DOE has chosen to opt for an air exchanger. It is not clear if this air exchanger would be readily available. It is clear, however, that DOE is overly concerned about this matter. In portions of the country where cold weather requires good building practices to ward against infiltration, there is no indictation that low air exchange rates have had a negative effect on the residents of the homes.

For example, homes in Wisconsin and Minnesota which have been heavily insulated, provided with vapor barriers, and caulked and weatherstripped, seem even more livable than those older homes built with higher infiltration rates.

Certainly if obvious noxious pollutants do occasionally occur in the air in tightly built homes, whether they be from cigarette smoke, cooking odors or other sources, the occupants will open windows or doors or use exhaust fans to rid themselves of the pollutants. This temporary possible loss of energy will be more than made up by the energy savings which would accrue during the balance of the time the building is heated or cooled.

Additionally, lack of oxygen should be the real concern in the case of overly tight construction. This is not likely to occur in homes constructed using today's normal construction materials and practices. Using the typical single-story house given by DOE as a model, one can easily calculate the the amount of air needed for life support. This 42 foot by 28 foot house contains roughly 9400 cubic feet. In accordance with ASHRAE minimum standards, we might allow 300 cubic feet of fresh air per person per hour.* A house of this size might accomodate up to five people, thus requiring 1500 cubic feet of air change per hour. This would permit as little as .16 air changes per hour in this home, assuming all combustion air is brought in from outside directly to the furnace.

According to Table 4-20 in the Draft Environmental Impact Statement, current construction in mobile homes provides for .3 air changes per hour. This level is much lower than that for other single family residential structures (the same source shows a range of from .75 to 1.00 for single-family residences).

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*See ASHRAE Standard 62-73

No one has come forth with information indicating that mobile home living is hazardous due to the much lower air change rate than conventional homes. DOE should not avoid the "strict" case because of unfounded worries about indoor air pollution. The Draft Environmental Impact Statement itself states that .6 air changes per hour should not be considered as a minimum (or maximum) air infiltration rate since "sufficient data do not exist to make such a judgment".** The "strict" case should not be ruled out because of air pollution concerns.

The DOE discussion of air infiltration in the DEIS appears implicitly to accept poor quality installation of gas appliances. Properly installed gas furnaces and water heaters do not pollute the interior of homes. The DOE analysis mentions the introduction of outside air to the combustion areas of these appliances as a means of reducing any pollution problem. Outside air for combustion should be made a requirement, both to reduce the need for greater infiltration rates, and to save energy. There is no need to continue the use of ambient air asmakeup air for gas appliances (except currently designed gas cooking appliances). This is discussed further in another section of our comments.

E. DOE Life Cycle Cost Analysis

The method adopted by DOE to find lowest life cycle cost in the sample homes determines what DOE has termed the life cycle

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**We have concluded that currently available information on the radon gas issue does not lead to a clear conclusion. Thus, we take no position on infiltration as it relates to radon gas.

cost minima for a number of sample homes and locations. While we doubt that DOE's formula for LCC is the preferred one, for the sake of discussion we may assume that the formula and calculations are correct. Even so, the LCC "minima" depend largely on the selection of the energy saving investments which are used as inputs to the formula. This is borne out by some of the DOE results which indicate an apparent anomaly. This occurs when the low-infiltration case is studied (Page D-3, Energy Budget Levels Selection) or when night setback is evaluated (Page C-23, Energy Budget Levels Selection). In some instances, items which were previously determined to be cost effective are no longer cost effective when low infiltration or night setback is introduced. The real meaning of this is that DOE has added energy saving measures to their sample homes in the incorrect order.

To properly develop model homes for determining LCC, those items which provide the greatest benefit/cost ratios must be included in the order of descending size of the ratios. Night setback, for example, even if one assumes it could cost $40 more initially for a setback thermostat, would be included in the low energy use home before triple glazed windows or very heavy levels of ceiling insulation (over R-38) are added to the model. Only when using the proper order can one get a proper indication of the real world benefits of adding the extra glazing or the additional insulation.

It is possible that DOE has performed this analysis in this manner intentionally. If so, the motivation would likely be to save as much energy as is possible. This would result because the homes built pursuant to BEPS would contain most of the structural attributes, such as high-R-value-walls and ceilings, that prevent a great deal of heat loss. At the same time, it is reasonable to assume that builders and purchasers of new homes will see to it that such things as clock thermostats and vapor barriers are installed in these homes. They will do this because, even though these items may be left out of the final BEPS standards, they are economic and make sense to install. Again, if they are economic as retrofit items under the RCS program, they are even more economic during new construction.

If the BEPS are adopted as proposed, one could make the case that more energy would be saved than if the conservation investments had been assumed in the proper order when developing the sample homes. At the same time, if one concludes that the DOE assumptions about fuel prices and costs of conservation are correct (which we do not), the net result to homebuyers would be higher life cycle costs. In the words of DOE, the LCC "minima" would not have been used.

Given the low fuel escalation rates used in the current BEPS proposal, one must assume that new home buyers are buying some conservation measures that would not be warranted if the proper order for selecting the conservation measures had been followed. However, if one looks at more realistic fuel escalation rates, the DOE results in terms of glazing and insulation levels are too high, and in fact even more money could be efficiently expended on conservation. Use of low energy price projections only encourages the continued production of inefficient goods, such as automobiles and homes which have exorbitant rates of energy use.

F. Outside Air for Combustion

At one point in the DOE analysis of BEPS there seems to be an assumption that rapid adoption of the use of outside combustion air will take place soon in new construction. One way to insure that this takes place would be for BEPS to require its use in all gas and oil heated homes. Again it is an item which has been found cost effective in another federal program (the FmHA standards discussed above). It is also an item which more appropriately lends itself to installation at the time of new construction. It has a better benefit/cost ratio than some of the things currently included in BEPS*.

Provision of outside combustion air is a basic building block of energy conservation and should be included as a requirement in BEPS. This would also reduce some of the current concern about the products of combustion mixing with the ambient air in the occupied spaces of the home.

G. Periodic Updating of the BEPS Standards

BEPS should be updated on a regular basis as new building techniques and materials are developed and as new price projections are produced. However, the implication of the fairly high level of concern at DOE about updating these standards is that DOE may not be too certain about the low energy cost escalations used.

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*Various studies show the use of outside combustion air with a cost of approximately $100-$150 can save at least 10% of the energy used for heating. See: Graydon Peoples, Sealed Oil Furnace Combustion System, Marshalltown, Iowa, Lennox, Inc. 1976 or Hittman Associates, Residential Energy Conservation: (A Summary Report), Washington, D.C., U.S. Department of Housing and Urban Development, 1974.

It should be readily understood by all that once built, it is much more expensive to retrofit homes to upgrade them to any then-current standards than it would have been to build them well during the initial construction stage. Given the DOE concern about this matter, and the likelihood that energy prices will continue to rise at a rapid pace, the best approach is to err in favor of energy conservation rather than to require only those things which are cost-justified using DOE's improbably low energy price projections.

H. Salvage Value and Extended Useful Life of Energy Investments

The DOE life cycle cost analyses assume no continuing or "salvage" value for energy investments. On the contrary, many of these investments will be worth more in the future than the original cost. In the used housing market, potential buyers do and will continue to realize that retrofitting insulation in walls, for example, is a very expensive proposition. This will be reflected in an additional premium which they will be willing to pay for houses which are already energy efficient.

The DOE assumption of no salvage value for these investments provides that a positive addition to the present value calculation is left out. Instead, the DOE analysis goes into detail about payback periods. Discussions of payback periods generally assume no residual or salvage value from the day the item is purchased and also ignore savings generated after the point of "payback". To get a payback, given the way this is usually discussed, one must retain the investment for a certain number of years until the savings per year caused by the investment equals the purchase cost. This type of analysis simply does not apply easily to investments in items which have large and readily available salvage values. In the cases at hand the salvage values are likely to be larger than the original cost. If one is to perform a correct "payback" analysis, the discounted salvage value must be deducted from the original cost, with the remaining cost or benefit compared to the stream of benefits accruing from the investment. If this is done for many of the energy investments under consideration, we are certain that payback periods will be very short, and even negative (whatever that implies, other than the fact that such "payback" calculations are not appropriate for investments of this type.)

I. Weighting System

The introduction of a weighting system into the calculations necessary to determine the compliance of a building with BEPS needlessly complicates the situation. Buildings should be constructed to be energy efficient without regard to their energy source. The weighting system adopted is based on DOE assumptions of current and projected energy prices. There is strong reason to believe that these assumptions are incorrect. Many of them are based on the notion that current energy policies will be continued in the future, and that the results of these policies will be the ones intended. In contrast, it is clear that the result, given human ingenuity, has not been exactly what was originally intended.

DOE should adopt a single strict standard (which incorporates adjustments for climate variations) for homes without regard to heat source. Given the changing relationships between the prices of various fuels, there is no reason to believe that homes built with one fuel in mind will always continue to use that fuel; witness, the current massive conversion from fuel oil to natural gas where it is available. One can conceive of one or more such switches during the lifetime of houses built under BEPS. Any weighting system is at best an artificial attempt to model or substitute for the market system, which though imperfect, is readily understood by most individuals contemplating the purchase of new homes.

J. Sizing of Heating Equipment

As an indication that BEPS must contain at least some prescriptive elements, we offer the following regarding furnace sizing. Research by various individuals* has shown the importance of proper sizing of furnaces in homes. If furnaces are of a size larger than necessary to provide sufficient heat on the coldest day of the year, cyclical and yearly efficiency of the heating plant is lowered, thus wasting energy. Because builders and contractors generally prefer to avoid complaints about insufficient heat from homebuyers, they tend to install larger equipment than necessary. BEPS will require that a home heated by a specified fuel and located in a specified climate would not be permitted a heat loss greater than a specified amount. This does not prevent someone from installing heating equipment of a much larger size. For example, a home calculated to need a furnace output of 100,000 BTU per hour might have a furnace installed with an output of 150,000 BTU per hour.

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*For Example, see ABT Associates, Inc., Cost-Effective Methods to Reduce the Heating and Cooling Energy Requirements of Existing Single-Family Residences, U.S. Department of Housing and Urban Development, Washington, D.C., February, 1975 (NTIS No. PB-2111 919).

Appliance efficiency programs being developed by DOE would have no effect on this situation since they deal only with the efficiency of the equipment under the proper conditions. The possible and likely result of neither BEPS nor the efficiency program addressing this matter is that an oversize furnace is installed, with resultant energy waste. Some oversizing must be permitted because furnaces are not available in an infinite variety of sizes and the builder must be permitted to oversize enough to provide comfortable heating in the home. However, BEPS, should contain a requirement that furnaces may be oversized by more than a specified amount (for example, 15%).

K. Equipment Standards

The proposed BEPS ignore equipment efficiencies and assume that other DOE programs, such as the Appliance Efficiency Program (AEP) will somehow ensure that all equipment installed in these homes will be efficient. Without getting into appliances which have no relation to building construction and building standards, BEPS could have a very favorable impact on improving energy efficiency of certain appliances, if it were revised with that objective in mind.

For example, DOE should change BEPS to prohibit the installation in new homes of any gas furnaces or water heaters which contain continuously burning pilot lights. These are both items which are installed during initial construction and are appropriate for such sanctions by DOE. There appears to be no other way to quickly ensure the adoption of spark ignition devices.

Another area in which DOE should modify BEPS is to require a minimum Energy Efficiency Ratio for all air conditioning equipment installed during initial construction, rather than waiting for the AEP standards (which are unknown at this time).

Neither the extra energy lost by an inefficient air conditioner in converting electricity to cool air nor the amount of gas wasted to operate a continuously burning pilot light is covered by the current BEPS proposal. This should be corrected in the final version.

L. Summary and Recommendations for Changes in the Final BEPS

As mentioned earlier, the BEPS, as proposed, are a good first step in the right direction. However, there are a number of changes which should be made to the proposal in order to strengthen it and to provide a better investment return for those buying new homes. Several million dollars have already been spent on the development of these standards; an additional expenditure to revise them should be made. We feel that the following changes or additions to the proposed BEPS will greatly improve their usefulness.

1. Standards for houses should be more prescriptive than provided for in the draft. There are a number of conservation measures which should be required. The nature of one and two family housing construction lends itself better to standards

which are more prescriptive than performance-oriented. For larger buildings, which normally involve a greater proportion of design work, performance standards are quite proper. In any case, prescriptive standards coupled with performance standards as an option, should satisfy those wishing to develop innovative techniques while at the same time satisfying the intent of the legislation.

2. The weighting scheme should be eliminated entirely. Any weighting method adopted at this time will be incorrect in the not-so-distant future. Weighting is cumbersome and unnecessary.

3. A single standard for housing construction, adjusted for climate is much preferred over a different standard for each fuel. Houses should be constructed with energy-efficiency in mind no matter what the fuel. DOE should develop an information-providing process for new home buyers to let them know that certain types of fuel are currently expected to cost more in the long run and the advantages of going beyond the required conservation levels.

4. There will be continued discussion about "payback" periods by those opposed to all or part of BEPS. DOE should consider that "payback" calculations alone, because they ignore the continuing value of an investment and all savings beyond the "payback" point, are not appropriate for most energy conservation investments in new home construction.

5. BEPS should include an outright ban on installation of continuous pilot gas furnaces and water heaters in new homes. A phase-out period should be permitted for reducing inventory stocks of those appliances already in production at the time of the adoption of BEPS.

6. DOE should opt for the "strict" case, incorporating low infiltration and including vapor barriers and caulking and weatherstripping. The energy savings are substantial and the vapor barrier is an absolute must to ensure the protection of the consumer from potential moisture damage.

7. Consumers must be protected by a requirement for the proper amount of free air ventilation above ceiling or attic insulation. Moisture damage can be extensive in homes without adequate ventilation, causing the need for very expensive repairs.

8. BEPS must include a prohibition against oversizing furnace capacity. Without this prohibition, the efficiency of the home and its heating system combined may be reduced when builders install equipment larger than is needed.

9. The hot water energy budget levels specified in the proposed BEPS are very large in proportion to the heating and cooling energy budget levels. In fact, for small homes and/or warm climates the water heating allowance may be even larger than that allowed for heating and cooling. Because

of this, BEPS should take some responsibility for the efficiency of the water heating which is permitted. This is another area in which a specification is required. BEPS should require (until greater insulation becomes standard on water heaters) that all new water heaters be wrapped with supplementary insulating blankets designed for this purpose. These low cost insulation measures will provide a high return on the investment.

10. Outside combustion air must be specified for all furnaces using combustion. This is needed for a number of reasons, including the high energy savings return on the extra cost of installation, and the fact that new tightly built homes will have reduced amounts of air and oxygen which, without outside combustion air, must be shared between the occupying family and the heating furnace and the water heating equipment.

An alternative to outside combustion air, which will save considerable energy*, but which will not completely solve any of the health problems DOE associated with tightly constructed homes, is to require the installation of flue vent dampers on furnaces. These devices will provide high returns for the investment made by homeowners.

11. Night setback thermostats provide another opportunity for a very high return on the homeowner's investment. It is cheaper to install these during the time of new construction than to install a regular thermostat, and to replace it later with a

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*Hittman and Peoples, op. cit.

setback model. These thermostats should be included in the set of minimum requirements included in BEPS.

12. The DOE price projections are, simply put, much to low. The sensitivity anslysis on fuel costs performed by DOE during its life cycle cost calculations examined the effects of using different fuel costs, and to a lesser degree different escalation rates. These analyses, however, were limited to very small changes from the DOE base case.

As we demonstrated in part II above, examination of larger deviations from DOE energy cost and escalation base case indicates that a great deal more may be spent on conservation and alternate energy supply while still providing a good investment return for the home buyer.

DOE should re-examine the energy use levels contained in BEPS using not only more current energy prices, but also more reasonable price projections based on events which have occurred in recent years.

Appendix A: A Life Cycle Cost Model

1.0 This model computes the present value of life cycle costs for an energy-efficiency improvement. It is anticipated that it will be used with a programable calculator, in this instance an HP-67, HP-97 or HP-41C. Similar machines, of course, may also be used. The components of the model are

(1.1) initial capital costs for acquisition and installation defined as: C

(1.2) The percentage down payment defined as:

$+ d(C)$

(1.3) The discounted present value of mortage payments defined as:

$$+ (1-d)\,C\left[\frac{r\,(1+r)^N}{(1+r)^N-1}\right]\left[\frac{(1+i)^N-1}{i(1+i)^N}\right]$$

where: r = mortgage rate
N = mortgage term
i = discount rate

(1.4) The discounted present value of annual maintenance, operation and insurance expenses defined as:

$$+ M\cdot\sum_{j=0}^{L-1}\left(\frac{1+m}{1+i}\right)^j$$

where: M = annual expense for O&M and insurance
m = annual rate of change in M
L = expected life of the improvement

(1.5) The discounted present value of primary source fuel expenses

defined as:

$$+ F_o \cdot \sum_{j=o}^{L-1} \left(\frac{1+f_o}{1+i}\right)^j$$

where: F_o = annual fuel expenses, primary source

f_o = annual rate of change in F_o

(1.6) The discounted present value of auxiliary source fuel expenses

defined as:

$$+ F_a \cdot \sum_{j=o}^{L-1} \left(\frac{1+f_a}{1+i}\right)^j$$

where: F_a = annual fuel expense, auxiliary source

f_a = annual rate of change in F_a

(1.7) The discounted present value of property tax, net of income tax deduction

defined as:

$$+ (A \cdot p)(1-t) \cdot \sum_{j=o}^{L-1} \left(\frac{1+a}{1+i}\right)^j$$

where: A = assessed value
p = property tax rate (%)
t = marginal income tax rate (%)
a = annual rate of change in A

(1.8) The discounted present value of the mortgage interest deduction from income for tax purposes

defined as:

$$- t \cdot \sum_{j=0}^{N-1} \left[\frac{L_j \cdot r}{1+i} \right]^j$$

where: L_j = mortgage balance in year j.

2.0 Transformations for Computational Purposes

To facilitate use of the model on other than high speed devices, transformation to non-iterative form is appropriate. The forms used here are as follows:

Since expressions (1.4) through (1.7) are geometric progressions, the transformation is:

$$(2.1)\quad Q \cdot \sum_{j=0}^{N-1} \left[\frac{1+\alpha}{1+\beta}\right]^j = Q \, \frac{1-\left[\frac{1+\alpha}{1+\beta}\right]^N}{1-\frac{1+\alpha}{1+\beta}}$$

Expression (1.8) is somewhat different since L_j is a decreasing quantity. L_j, the mortgage balance in year j, is determined by

$$(2.2)\quad L_j = Q \cdot \frac{1-(1+r)^{j-N}}{r}$$

where: Q = constant annual mortgage payment and since:

$$(2.3)\quad Q = (1-d)\,C\,\frac{r}{1-(1+r)^{-N}}$$

then, by substitution, expression (1.8) becomes:

$$t \cdot \sum_{j=0}^{N-1} r \cdot \left[\frac{C\,(1-d)\,\frac{r}{1-(1+r)^{-N}} \quad \frac{1-(1+r)^{j-N}}{r}}{(1+i)^j}\right]$$

$$= (1-d)\,C\,r\,t \sum \left[\frac{(1+r)^N - (1+r)^j}{(1+r)^N - 1} \cdot \frac{1}{(1+i)^j} \right]$$

$$= \frac{(1-d)\,C\,r\,t}{(1+r)^N - 1} \left[\sum_{j=0}^{N-1} \frac{(1+r)^N}{(1+i)^j} - \sum_{j=0}^{N-1} \left[\frac{1+r}{1+i}\right]^j \right]$$

$$= \frac{(1-d)\,C\,r\,t}{(1+r)^N - 1} \left[(1+r)^N \cdot \sum_{j=0}^{N-1} \frac{1}{(1+i)^j} - \sum_{j=0}^{N-1} \left[\frac{1+r}{1+i}\right]^j \right].$$

$$= \frac{(1-d)\,C\,r\,t}{(1+r)^N - 1} \left[(1+r)^N \cdot \frac{1-(1+i)^{-N}}{1-(1+i)^{-1}} - \frac{1 - \left[\frac{1+r}{1+i}\right]^N}{1 - \frac{1+r}{1+i}} \right] \tag{2.4}$$

, which is readily programmable.

3.0 Model Restrictions

There are certain computational restrictions which result from the particular way in which the above transformations are stated. Specifically, the following conditions must be observed:

(3.1) $N \neq 0$
(3.2) $i \neq 0$
(3.3) $r \neq 0$
(3.4) $i-r \neq 0$.

In practice, these restrictions may be avoided by substituting values trivially different from zero, for example 7.0001% instead of 7.0000% when both r and i should be 7.0%, or 0.0001% when i = 0 is intended.

4.0 Using the Model

The user enters values of the variables using the following mnemonic keyboard labels. Percentages are entered as integers (e.g. use 10, not .10 for 10%)

d - percentage down payment
C - capital cost
i - discount rate
L - economic or useful life of the asset
r - mortgage rate
N - mortgage term
t - marginal income tax rate
p - property tax rate
F_o - annual fuel expense, primary source
f_o - rate of change in F_o
F_a - annual fuel expense, auxiliary source
f_a - rate of change in F_a
M - annual maintenance expense
m - rate of change in M
A - assessed value
a - rate of change in A

Subject to the restrictions in 3.0, no value need be entered where an expression does not apply to a given case. Once a set of values has been entered for a run, only those different values which are to be changed in subsequent runs need be entered; variables not changed are retained.

VARIABLES ARE KEYED IN PAIRS, as shown on the program card, and BOTH ELEMENTS OF THE PAIR MUST BE ENTERED TOGETHER, but pairs may be entered in any sequence. E.g. "t" and "p" constitute a pair. Neither can be entered alone or with any other variable.

To enter data, press

value of first element in pair $\boxed{\text{ENTER}}$

value of second element in pair $\boxed{\text{Label}}$ or $\boxed{\text{f}}\,\boxed{\text{Label}}$*

and ignore what is displayed.

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*Use $\boxed{\text{Label}}$ if a bottom row pair

Use $\boxed{\text{f}}\ \boxed{\text{Label}}$ if a top row pair

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To execute the program, press $\boxed{\text{f}}\ \boxed{\text{e}}$. The present value of life cycle costs will be displayed. If a list of the values of the components of life cycle costs is desired, press $\boxed{f}$ $\boxed{d}$ before pressing $\boxed{f}$ $\boxed{e}$. The component values are presented in the order (1.1) through (1.8), above, followed by their sum.

5.0 Test Values

Verify accurate execution by using the following test data

Data	Results
d = 20	
C = 10000	2,000.00
r = 7	
N = 10	6,998.78
i = 10	
L = 30	4,058.51
F_o = 100	
f_o = 1	1,127.81
F_a = 200	
f_a = 2	2,464.53
M = 300	
m = 3	208.96
t = 30	
p = 5	-770.94
A = 400	
a = 4	16,087.67

6.0 Program Listing

The listing contains 222 steps, uses one flag, 14 labels including four subroutines, and 22 registers. Secondary registers six through nine are available to the user.

PROGRAM CARD

M/m	t/p	A/a	PNT_i	XQT
d/C	r/N	i/L	F_o/f_o	F_a/f_a

Registers Initialized to Test Values

Primary				Secondary	
10000.00	A	0.10	0	0.02	0
0.20	B	0.03	1	200.00	1
10.00	C	300.00	2	0.04	2
0.07	D	0.01	3	400.00	3
30.00	E	100.00	4	0.05	4
1.10	I	0.00	5	0.30	5
		0.00	6	0.00	6
		0.00	7	0.00	7
		1.07	8	0.00	8
		0.00	9	0.00	9

PROGRAM

```
001  *LBLA  033   GSB0  065  *LBLe  097   RCL7  129    R↓  161    P⇄S  193   RCLE
002   STOA  034   STO0  066    SPC  098      x  130  STO5  162      x  194    Y^x
003    X-Y  035    X-Y  067    SPC  099   GSB4  131  GSB2  163      x  195      -
004   GSB0  036   STO1  068   RCLA  100   RCL2  132     1  164      x  196     X-
005   STOB  037    P-S  069   RCLA  101   STO5  133  RCLI  165   RCL8  197    RCL
006    RTN  038    RTN  070   RCLB  102   RCL1  134  GSB3  166   GSB3  198      +
007  *LBLB  039  *LBLa  071      x  103   STO6  135   1/X  167      1  199 [illegible]
008   STOC  040   GSB0  072   GSB4  104   GSB2  136     -  168      -  200   RCL0
009    X-Y  041   STO1  073   STO9  105   RCL4  137     1  169      ÷  201      +
010   GSB0  042    X-Y  074      -  106   STO5  138  RCLI  170    CHS  202      ÷
011   STOD  043   STO2  075   STO7  107   RCL3  139   1/X  171   GSB4  203    CHS
012      1  044    RTN  076   RCLD  108   STO6  140     -  172    SPC  204      1
013      +  045  *LBLb  077   RCL8  109   GSB2  141     ÷  173   RCL9  205      +
014   STO8  046    P-S  078   GSB3  110    P-S  142  RCL8  174   PRTX  206      ÷
015    RTN  047   GSB0  079      x  111   RCL1  143  GSB3  175    CF0  207   RCL5
016  *LBLC  048   STO4  080   RCL8  112   RCL0  144     x  176    RTN  208      x
017   STOE  049    X-Y  081   GSB3  113    P-S  145     1  177  *LBL0  209    RTN
018    X-Y  050   GSB0  082      1  114   STO6  146  RCL8  178      1  210  *LBL2
019   GSB0  051   STO5  083      -  115      R  147  RCL1  179      0  211   GSB1
020   STO0  052    P-S  084      ÷  116   STO5  148     ÷  180      0  212   GSB4
021      1  053    RTN  085   STO6  117   GSB2  149  STO5  181      ÷  213    RTN
022      +  054  *LBLc  086   RCLI  118      1  150  GSB3  182    RTN  214  *LBL3
023   STO1  055    P-S  087   GSB3  119    P-S  151     +  183  *LBL1  215    RCL
024    RTN  056   GSB0  088      1  120   RCL5  152     1  184      1  216    Y^x
025  *LBLD  057   STO2  089      -  121      -  153  RCL5  185   ENT↑  217    RTN
026   GSB0  058    X-Y  090   RCL0  122   RCL3  154     -  186      1  218  *LBL4
027   STO3  059   STO3  091   RCLI  123      x  155     ÷  187   RCL6  219    STO
028    X-Y  060    P-S  092   GSB3  124   RCL4  156     -  188      +  220    FC?
029   STO4  061    RTN  093      x  125      x  157  RCL7  189   RCL0  221   PRTX
030    RTN  062  *LBLd  094      ÷  126   RCL2  158  RCLD  190      1  222    RTN
031  *LBLE  063    SF0  095   RCL6  127    P-S  159   P-S  191      +  223    R/S
032    P-S  064    RTN  096      x  128   STO6  160  RCL5  192      ÷
```

APPENDIX II

THERMAL AND ECONOMIC STUDIES OF THE
BEPS RESIDENTIAL STANDARDS

by

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(Revised)

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CONSUMER ENERGY COUNCIL OF AMERICA

SUMMARY AND CONCLUSIONS

The hourly simulation model SUNCAT was used to examine the effects of window orientation, thermal mass, and increased insulation levels on residential heating and cooling loads in Bismarck (9180 DD) and North Omaha (6200 DD). The main results are noted below. Load reduction and net present value are reckoned from the BEPS recommended levels.

- Residential heating and cooling requirements are an extremely complex function of latitude, distribution of cloudiness through the year, orientation of windows, color of exterior surfaces, the overall heat loss coefficient of the building, the magnitude and timing of internal gains due to appliances and occupants, thermostat settings and schedules for heating and cooling, the thermal capacity of the building, and the presence of earth contact (especially for cooling loads). This complexity makes generalization both difficult and risky.

- Moving glass onto the south face of the building decreases heating loads and total energy required provided there is adequate heat capacity to store the additional solar gains. For the low mass cases, heating loads are reduced about 8% by moving all glass onto the south side. The net present value of doing this for an electrically-heated house varies from -$40 to $1620. For high mass, these figures are 16% to 20% and $2900 to $3200.

- Adding mass reduces heating loads and total energy significantly if there are substantial solar gains.

- Adding mass and moving all glass to the south reduces heating loads by 20% to 30% and has a net present value for all-electric houses of $3700 to #5300, assuming that the addition of a slab floor and moving glass has no incremental cost. This should be compared with the net present value of the BEPS insulation options which are $5400 to $8500 for these locations.

- There is no additional benefit to be derived from increasing south glass areas beyond 300 ft^2 for the high mass cases studied here.

- Savings from the low-infiltration option are similar in magnitude to the south glass with slab floor option.
- In comparison with the equal distribution case, placing 50% of the glass on the south and 50% east and west provides about half the relative benefit of placing all the glass on the south.
- Detailed analysis of wall sections shows that R-values as high as R-53 are cost-effective against electric resistance heat in an 8000 degree-day climate, using the BEPS economic assumptions for energy costs and the National Construction Estimator for initial costs of wall options.
- Using the BEPS cost assumptions for ceiling insulation results in optimum R-values for electric heat from R-74 at 8000 degree-days to R-52 at 4000 degree-days. For natural gas heat the optimums are R-50 at 8000 degree-days and R-25 at 4000 degree-days. Although these calculations are based on heating loads only, they agree well with the results of the insulation computer runs presented, which also take account of the increase in cooling loads. Using the National Construction Estimator costs for fiberglass batts reduces the optimum R-values by about 26 percent.
- Increasing the ceiling insulation above the BEPS levels, while cost-effective, reduces loads and total operating costs by only two or three percent. Increasing the wall insulation from R-25 overall to R-53 (where cost-effective) produces savings of about 8 percent for the two-story house studied here.

ANALYSIS OF
WINDOW ORIENTATION &
THERMAL MASS

ASSUMPTIONS FOR BASE CASE

The basic house design used for this study is the Hastings two-story model reported in NBSIR-1309. The house design and operating assumptions were chosen to be as consistent as possible with those used for the residential BEPS study reported in the BEPS economic support document. These include the following:

* It is assumed that there is no heat loss or gain from the basement.

* Twenty percent (20%) of the wall area is 2X6 studs; insulation between studs is R-19 with R-8 sheathing on the exterior. Average R-value is 25.7.

* Roof insulation is R-38; ten percent (10%) of the roof area is joists. Average R-value is 37.5.

* Infiltration is assumed constant at .6 air changes per hour. Total loss rate due to infiltration is 176 Btu/F·h.

* Effective thermal storage in assumed to consist of the gypsum wallboard on the exterior walls plus wallboard on the interior walls plus one inch of wood for the gross floor area. Total storage is 5395 Btu/F.

* Windows are fifteen percent (15%) of the floor area and evenly distributed over the four cardinal directions. The triple-glazed windows have an air-to-air U-value of .32. No external shading of windows.

* The heating thermostat is set at 70°F. The BEPS residential study assumes that if the interior temperature reaches 78°F and the outside temperature is below 78°F, the occupant opens windows to achieve 10 air changes per hour. If this is not adequate to maintain the 78°F comfort level, the windows are kept closed and the air conditioner is turned on. The version of SUNCAT used for most of the runs here calculates total cooling load. Ventilation is assumed to supply 40% of this cooling load.

* The air conditioner is assumed to have a seasonal coefficient of performance of 2.3.

* Internal gains from appliances and people are constant at 2212 Btu/hr.

* Total heat loss coefficient is 463 Btu/F·h.

* Gross areas are: Floor = 2040 sq. ft.
  Wall = 2194 sq. ft.
  Ceiling = 1020 sq. ft.

VARIATIONS

In order to explore the effect of window orientation on heating and cooling requirements, we examined a number of variations of the basic design as follows:

- Shading Assumptions

  The BEPS residential study assumes a shading coefficient of .6 for single glazing and proportional reduction for double and triple glazing. This is equivalent to assuming that 40% of the solar heat gain is rejected due to medium weave light-colored curtains being closed over the windows about half of the daylight hours. Reflection losses in a medium colored room are estimated by researchers at NCAT and Los Alamos to be on the order of 5% during the winter months. For this study we used both 40% and 5% radiation losses.

  It should be noted that the DOE-2 program uses Test Reference Year (TRY) weather data which does not include solar radiation data. The solar radiation is manufactured by multiplying an ASHRAE clear day calculation by a cloud modifier based on cloudiness data on the TRY weather tape. For this study we used the Typical Meteorological Year (TMY) weather tapes for North Omaha (6200 DD) and Bismarck (9180 DD). A recent paper by John Anderson of Solar Energy Research Institute compared the total horizontal radiation generated by DOE-2 using TRY with that on the TMY tapes for the twenty stations common to both data bases. The paper shows the DOE-2/TRY horizontal radiation to be 50% greater than the TMY data, indicating the BEPS studies may have overestimated the solar availability. A limited comparison of the heating and cooling loads generated in this study with those presented in the Active and Passive Solar Heating BEPS support document shows that the BEPS values fall between our 40% and 5% loss results, being closer to the 5% values. We suspect the 5% figures are more closely comparable with the previous BEPS work and have given them greater emphasis.

- Mass Assumptions

  In the low mass cases the effective thermal storage is restricted to the ½" interior wallboard on walls and ceilings and 1" of wood on the floors. Contribution to storage of both interior and exterior wood framing was neglected. This is perhaps too conservative. For the high mass cases we assumed the addition of 2040 square feet of 6" thick concrete, representing a floor slab or its equivalent in interior walls. This gave a total heat capacity of 32,100 Btu/F.

* Natural Ventilation

Since a modified version of the SUNCAT model to explicitly implement the BEPS ventilation of 10 air changes per hour was not available until this study was nearly complete, we calculated total cooling loads and assumed that 40% of this total load could be removed by ventilation. Several runs with the modified version showed that 38% to 42% of the cooling load could be so removed. They also showed that a strategy of using the full 10 air changes per hour when the interior temperature reaches 78°F results in as much as a 10% increase in heating loads due to unnecessary cooling. This should be investigated in further BEPS simulation work.

* Orientation Assumptions

In the base case the glass was assumed to be distributed with an equal amount facing each cardinal direction. To show the maximum effect of orientation we ran cases with all of the glass facing north and all of the glass facing south. We also made two runs with 50% of the glass on the south and 50% east and west.

* Low Infiltration

We made one run to examine the impact of very tight construction combined with an air-to-air heat recuperator to produce an effective infiltration rate of .2 air changes per hour, or a two-thirds reduction in infiltration losses.

COMPARISON OF "CONVENTIONAL" HOUSE
WITH BASE CASE
FOR THIS STUDY

Conventional House: R-11 wall insulation, R-19 roof insulation, Triple-glazed, Electric Heating and Cooling.

Description	Heating Energy mmBtu/y		Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy 1979 $	Net Present Value 1979 $
BISMARCK						
5% Shading Loss						
Conventional	109.20		5.25	114.45	35,760	
Base Case	77.64	-29%	5.85	83.49	26,090	8566
NORTH OMAHA						
5% Shading Loss						
Conventional	70.41		7.48	77.89	24,340	
Base Case	49.01	-30%	8.06	57.07	17,830	5406

NOTE: Cost of conservation calculated as follows: (see BEPS economic support document)

1874 ft^2 of wall times \$.48/ft^2 = \$900

1020 ft^2 of ceiling times \$.20/ft^2 = 204

\$1104

COMPARISON OF LOW-INFILTRATION
WITH BASE CASE
(Electric Heating & Cooling)

Description	Heating Energy mmBtu/y	Cooling Energy mmBtu/y	Total Energy mmBtu/y	Life-cycle Cost of Energy 1979 $	Net Present Value 1979 $
NORTH OMAHA (Base)	49.01	8.06	57.07	17,830	--
LOW-INFILTRATION	30.71 (-37%)	8.86	39.57	12,360	4470

NOTE: Net Present Value assumes low-infiltration option costs $1,000.

EFFECT OF GLASS ORIENTATION WITH LOW MASS
(Electric Heating and Cooling)

Description	Heating Energy mmBtu/y		Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy 1979 $	Net Present Value 1979 $
BISMARCK						
5% Shading Loss						
North	86.91	+12%	2.99	89.90	28,090	-2000
Base	77.64		5.85	83.49	26,090	
South	71.34	-9%	8.95	80.29	25,090	1000
NORTH OMAHA						
5% Shading Loss						
North	57.12	+17%	4.94	62.06	19,390	-1560
Base	49.01		8.06	57.07	17,830	
South	45.70	-7%	11.49	57.19	17,870	- 40
BISMARCK						
40% Shading Loss						
North	91.52	+8%	1.72	93.24	29,130	-1790
Base	84.39		3.12	87.51	27,340	
South	77.94	-8%	4.36	82.30	25,720	1620
NORTH OMAHA						
40% Shading Loss						
North	60.76	+12%	3.24	64.00	20,000	-1540
Base	54.27		4.82	59.09	18,460	
South	49.27	-9%	6.04	55.31	17,280	1180

EFFECT OF GLASS ORIENTATION WITH HIGH MASS
(Electric Heating & Cooling)

Description	Heating Energy mmBtu/y		Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy 1979 $	Net Present Value 1979 $
BISMARCK						
5% Shading Loss						
North	84.26	+16%	2.24	86.50	27,030	-3070
Base	72.35		4.34	76.69	23,960	
South	60.47	-16%	5.97	66.44	20,760	3200
NORTH OMAHA						
5% Shading Loss						
North	54.91	+24%	4.33	59.24	18,510	-2580
Base	44.23		6.75	50.98	15,930	
South	34.49	-22%	8.33	42.82	13,380	2550
NORTH OMAHA						
40% Shading Loss						
North	59.29	+15%	2.84	62.13	19,410	-2010
Base	51.57		4.11	55.68	17,400	
South	42.76	-17%	4.32	47.08	14,710	2690

EFFECT OF ADDING MASS AND MOVING ALL GLAZING TO SOUTH

(Electric Heating and Cooling)

Description	Heating Energy mmBtu/y		Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy 1979 $	Net Present Value 1979 $
BISMARCK						
5% Shading Loss						
Base	77.64		5.85	83.49	26,090	
South, Mass	60.47	-22%	5.97	56.44	20,760	5330
NORTH OMAHA						
5% Shading Loss						
Base	49.01		8.06	57.07	17,830	
South, Mass	34.49	-30%	8.33	42.82	13,380	4450
NORTH OMAHA						
40% Shading Loss						
Base	54.27		4.82	59.09	18,460	
South, Mass	42.76	-21%	4.32	47.08	14,710	3750

COMPARISON OF 50% SOUTH/50% EAST AND WEST GLASS WITH EVEN DISTRIBUTION AND ALL SOUTH CASES - NORTH OMAHA

(Electric Heating & Cooling)

Description	Heating Energy mmBtu/y	Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy 1979 $	Net Present Value 1979 $
LOW MASS					
Even	49.01	8.06	57.07	17,830	0
50% S 50% E/W	46.55	9.77	56.32	17,600	230
South	45.70	11.49	57.19	17,870	-40
HIGH MASS					
Even	44.23	6.75	50.98	15,930	0
50% S 50% E/W	39.02	7.71	46.73	14,600	1330
South	34.49	8.33	42.82	13,380	2550

EFFECT OF GLASS AREA ON LOADS FOR HIGH MASS HOUSES WITH ALL SOUTH GLAZING (Electric Heating & Cooling)

NORTH OMAHA

Glass Area ft²	Heating Energy mmBtu/y	Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy, 1979$
200	37.22	4.77	41.99	13,120
300	34.49	8.33	42.82	13,380
400	34.04	12.67	46.71	14,600
500	34.46	17.29	51.75	16,170
600	35.24	22.04	57.28	17,900

BISMARCK

200	63.79	3.11	66.90	20,903
300	60.74	5.97	66.44	20,760
400	59.32	9.52	68.84	21,510
500	59.68	13,54	73.22	22,880
600	60.77	17.79	78.56	24,550

SUMMARY OF SIMULATION RESULTS
FOR ELECTRICALLY HEATED 2040 SQUARE FOOT HOUSE

Location	Glass Orient.	Glass Area ft^2	Bldg. Mass	Heating[1] Energy mmBtu/y	Cooling[2] Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost[3] of Energy $	
SHADING LOSS = 40%								
Bismarck	North	300	Low	91.52	1.72	93.24	29,130	
	Even	300	Low	84.39	3.12	87.51	27,340	
	South	300	Low	77.94	4.36	82.30	25,720	
N. Omaha	N	300	Low	60.76	3.24	64.00	20,000	
	E	300	Low	54.27	4.82	59.09	18;460	
	S	300	Low	49.27	6.04	55.31	17,280	
N. Omaha	N	300	High	59.29	2.84	62.13	19,410	
	E	300	High	51.57	4.11	55.68	17,400	
	S	300	High	42.76	4.32	47.08	14,710	
N. Omaha	N	600	High	66.20	5.23	71.43	23,320	
	E	600	High	53.18	8.47	61.65	19,260	
	S	600	High	43.17	11.18	54.35	16,980	
SHADING LOSS = 5%								
Bismarck	N	300	Low	86.91	2.99	89.90	28,090	
	E	300	Low	77.64	5.85	83.49	26,090	(Base case for this study)
	S	300	Low	71.34	8.95	80.29	25,090	
Bismarck	N	300	High	84.26	2.24	86.50	27,030	
	E	300	High	72.35	4.34	76.69	23,960	
	S	300	High	60.47	5.97	66.44	20,760	
Bismarck	N	600	High	91.87	5.42	97.29	30,400	
	E	600	High	73.44	11.33	84.77	26,490	
	S	600	High	60.78	17.79	78.57	24,550	

[1] Heating energy calculated as heating load supplied at 100% efficiency by electric resistance. To obtain natural gas energy, divide by .7.

[2] Cooling energy calculated as 60% of total heat removed to maintain house at 78°F, with a seasonal coefficient of performance of 2.3.

[3] Present value of lifecycle fuel costs. Calculated at $12.90 per million Btu with a present worth factor of 24.22, yielding a multiplier of 312.455 times total electric energy used. See BEPS Economic Support Document, Appendix A.

Location	Glass Orient.	Glass Area ft	Bldg. Mass	Heating Energy mmBtu/y	Cooling Energy mmBtu/y	Total Energy mmBtu/y	Lifecycle Cost of Energy $	
Bismarck	South	200	High	63.79	3.11	66.90	20,900	
	South	400	High	59.32	9.52	68.84	21,510	
	South	500	High	59.68	13.55	73.23	22,880	
	Even	600	Low	84.69	14.53	99.22	31,000	
Bismarck	S[4]	300	High	61.48	5.84	67.32	21,030	
	E Conv.[5]	300, Triple	Low	109.20	5.25	114.45	35,760	
N. Omaha	N	300	Low	57.12	4.94	62.06	19,390	
	E	300	Low	49.01	8.06	57.07	17,830	(Base case for this study)
	S	300	Low	45.70	11.49	57.19	17,870	
N. Omaha	N	300	High	54.91	4.33	59.24	18,510	
	E	300	High	44.23	6.75	50.98	15,930	
	S	300	High	34.49	8.33	42.82	13,380	
N. Omaha	N	600	High	58.90	8.70	67.60	21,120	
	E	600	High	42.84	15.15	57.99	18,120	
	S	600	High	35.25	22.04	57.29	17,900	
N. Omaha	S	200	High	37.22	4.75	41.97	13,110	
	S	400	High	34.04	12.67	46.71	14,600	
	S	500	High	34.46	17.29	51.75	16,170	
N. Omaha	E[6]	300	Low	30.71	8.86	39.57	12,360	
	E Conv.[5]	300	Low	70.41	7.48	77.89	24,340	
N. Omaha	50%S,50E/W	300	Low	46.55	9.77	56.32	17,600	
	50%S,50E/W	300	High	39.02	7.71	46.73	14,600	
N. Omaha	S[4]	300	High	35.98	8.71	44.69	13,960	
	S[4]	600	High	38.80	21.25	60.05	18,760	

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[4] Natural ventilation at 10 air changes per hour used.

[5] Conventional: R-11 wall insulation and R-19 ceiling insulation; otherwise identical to base case.

[6] This run assumes use of airtight construction combined with a recuperator reduces infiltration losses to effective rate of .2 air changes per hour.

ANALYSIS OF ALTERNATIVE
WALL AND CEILING
SECTIONS

THERMAL AND ECONOMIC ANALYSIS OF ALTERNATIVE WALL SECTIONS

	Base Case 2X4 R-11 fbrgls batt	2X4 Add 1" extruded polystyrene R-5	2X4 Add 2" extruded polystyrene R-10	2X6 R-19 fiberglass batt	2X6 Add 1" extruded polystyrene R-5	2X6 Add 2" extruded polystyrene R-10	2X4 dbl stud R-41 fbrgls batt	2X4 dbl stud R-52 fbrgls batt
	A.	B.	C.	D.	E.	F.	G.	H.
R-Value F•h•ft^2/Btu	12.5	17.7	22.9	19.4	24.8	30.0	41.7	53.3
Cost, \$/ft^2	4.35	4.85	5.16	4.95	5.45	5.76	5.96	6.15
Incr. Cost \$/ft^2	0	.50	.81	.60	1.10	1.41	1.61	1.80
Annual Load Reduction Btu/ft^2• y 8000 DD Gas/Elec.	--	4512	6976	5463	7618	8960	10756	11758
6000 DD Gas/Elec.	--	3384	5232	4097	5714	6720	8067	8818
4000 DD Gas/Elec.	--	2256	3488	2732	3809	4480	5378	5879
Lifecycle[1] Benefit in 1979 \$/ft^2 8000 DD Gas	--	.64	.99	.79	1.09	1.28	1.53	1.67
Elec	--	1.41	2.18	1.71	2.38	2.80	3.36	3.67
6000 DD Gas	--	.48	.75	.58	.81	.96	1.15	1.26
Elec	--	1.06	1.63	1.28	1.79	2.10	2.52	2.76
4000 DD Gas	--	.32	.50	.39	.54	.64	.77	.84
Elec	--	.70	1.09	.85	1.19	1.40	1.68	1.84
Net Present Value 1979\$ 8000 DD Gas	--	.14	.18	.19	-.01	-.13	-.08	-.13
Elec	--	.91	1.37	1.11	1.28	1.39	1.75	1.87
6000 DD Gas	--	-.02	-.06	-.02	-.29	--	--	--
Elec	--	.56	.82	.68	.69	.69	.91	.96
4000 DD Gas	--	--	--	--	--	--	--	--
Elec	--	.20	.28	.25	.09	-.01	.07	.04

See Notes on following page.

R-VALUE OF WALL SECTIONS WITH HIGHEST NET PRESENT VALUES

Degree Days	Electric Heat	Gas Heat
8000	R-52 double-stud	R-19.4 2X6 studs
6000	R-52 double-stud	R-11 2X4 studs
4000	R-23 2X4 studs with 2" polystyrene	R-11 2X4 studs

Notes for Thermal and Economic Analysis on preceding page:

NOTE 1: Life-cycle benefits calculated as follows: (see BEPS Economic Support Document, Appendix A)

Electric: 312.455 times annual load reduction
Gas: 99.714/.7 = 142.449 times annual load reduction

NOTE 2: Analysis of the roof insulation, R-53 walls, and low infiltration computer runs indicates that the reduction in annual total energy from the BEPS recommended levels is within four percent of that calculated by multiplying the change in U-value times base 65 degree days for the building design and operating conditions of this study.

SIMULATION RUN
WITH R-53 WALLS

	Heating Energy mmBtu/y	Cooling Energy mmBtu/y	Total Energy mmBtu/y	Life-cycle Cost of Energy 1979 $	Net Present Value 1979 $
BISMARCK					
R-25 Walls (Base)	77.64	5.85	83.49	26,090	0
R-53 Walls	68.50	6.08	74.58	23,300	1759

NOTE: Conservation costs for NPV calculated as:

R-27 wall obtained by using 2X6 construction with 1½" polystyrene sheathing will have costs half-way between Section E and Section F in Appendix, or \$5.60/ft^2.

R-52 wall (Section H) costs \$6.15/ft^2. Incremental cost is \$.55/ft^2 X 1874 ft^2 = \$1031.00.

OPTIMUM R-VALUES FOR CEILING INSULATION

AT COST OF $.12/FT² FOR R-11 FIBERGLASS BATTS FROM BEPS ECONOMIC TSD

Degree Days	Electric Heat	Gas Heat
10,000	R-83	R-56
8,000	R-74	R-50
6,000	R-64	R-43
4,000	R-52	R-35

AT COST OF $.38/FT² FOR R-19 FIBERGLASS BATTS FROM NATIONAL CONSTRUCTION ESTIMATOR

Degree Days	Electric Heat	Gas Heat
10,000	R-61	R-41
8,000	R-55	R-37
6,000	R-47	R-32
4,000	R-39	R-26

NOTE: Optimum R-Value calculated as:

$$R_{opt} = \sqrt{\frac{DD \times 24 \times P_E}{P_R \times 10^6}}$$

where

R_{opt} = Optimum R-Value

DD = Heating Degree Days

P_E = Life-cycle Energy Cost Factor

= 312.455 for electric
= 142.449 for gas

P_R = Initial Cost of Insulation ($/R*ft²)

SUMMARY OF SIMULATION RUNS WITH ADDITIONAL ROOF INSULATION (Electric Heating & Cooling)

	Heating Energy mmBtu/y	Cooling Energy mmBtu/y	Total Energy mmBtu/y	Life-Cycle Cost of Energy 1979 $	Net Present Value 1979 $
BISMARCK (9180 DD)					
R-38 Roof (Base)	77.64	5.85	83.49	26,090	0
R-49 Roof	76.14	5.89	82.03	25,630	338
R-60 Roof	75.19	5.91	81.10	25,340	506
R-71 Roof	74.55	5.93	80.48	25,140	584
NORTH OMAHA (6200 DD)					
R-38 Roof (Base)	49.01	8.06	57.07	17,830	0
R-49 Roof	47.99	8.09	56.08	17,522	186
R-60 Roof	47.36	8.12	55.48	17,355	231

NOTE: Conservation costs for NPV as follows:

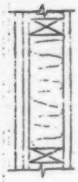
Cost of adding R-11 batt is \$.12/ft^2 X 1020 ft^2 = \$122
(See BEPS Economic Support Document)

APPENDIX

DETAILS OF WALL SECTION
COSTS AND R-VALUES

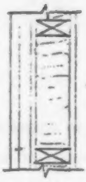
NOTE: The author wishes to acknowledge the valuable assistance of Robert Corbett and Dan Hagan of the NCAT Research Staff in preparing this Appendix.

WALL SECTIONS



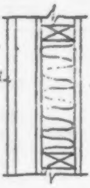
(A)

CONSTRUCTION:
2×4" STUDS @ 16" O.C.
3½" FIBERGLASS INSULATION
"R" VALUE:
R= 12.5
COST:
$4.35/FT^2 WALL



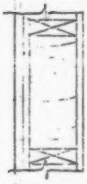
(B)

CONSTRUCTION:
2×4 STUDS @ 16" O.C.
3½" FIBERGLASS AND 1" RIGID INSUL.
"R" VALUE:
R = 17.7
COST:
$4.85/FT^2 WALL



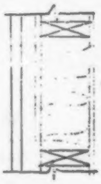
(C)

CONSTRUCTION:
2×4 STUDS @ 16" O.C.
3½" FIBERGLASS AND 2" RIGID INS
"R" VALUE:
R = 22.9
COST:
$5.16/FT^2 WAL



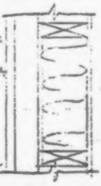
(D)

CONSTRUCTION:
2×6" STUDS @ 24" O.C.
5½" FIBERGLASS INSUL.
"R" VALUE:
R= 19.4
COST:
$4.95/FT^2 WALL



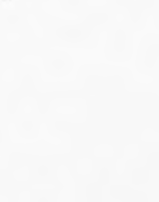
(E)

CONSTRUCTION:
2×6" STUDS @ 24" O.C.
5½" FIBERGLASS AND 1" RIGID INSUL.
"R" VALUE:
R= 24.8
COST:
$5.45/FT^2 WALL



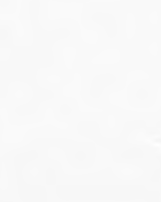
(F)

CONSTRUCTION:
2×6" STUDS @ 24" O.C.
5½" FIBERGLASS AND 2" RIGID INS.
"R" VALUE:
R= 30.0
COST:
$5.76/FT^2 WAL



(G)

CONSTRUCTION:
DOUBLE WALL, STAGGERED STUDS,
2"×4" @ 24" O.C. EA. SIDE
(2) R-11 BATTS (3½" EA.)
R-19 CENTER BATT (5½")
"R" VALUE:
R= 41.7
COST:
$5.96/FT^2 WALL

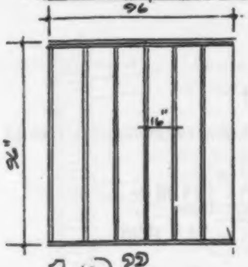


(H)

CONSTRUCTION:
DOUBLE WALL, STAGGERED STUDS,
2"×4" @ 24" O.C. EA. SIDE
(2) R-11 BATTS (3½" E
R-30 CENTER BATT (9")
"R" VALUE:
R= 53.3
COST:
$6.15/FT^2

[illegible]

FRAMING CORRECTION FACTORS



16" O.C.

WOOD AREA:

6(1.5× 91.5) + 3(1.5×96)

= 6 (137.25) + 3(144)

= 823.5 + 432

= 1255 sq. in of framing

TOTAL AREA:

(96 × 96)

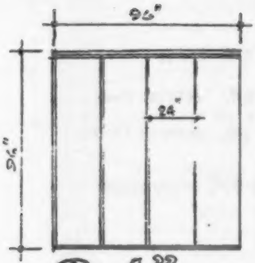
= 9216 sq. in.

NET INSULATED = 9216 − 1255 = 7961 sq

THEREFORE:

$\frac{1255}{9216}$ = 14% wood

$\frac{7961}{9216}$ = 86% insulation



24" O.C.

WOOD AREA:

4 (1.5×91.5) + 3(1.5×96)

= 4 (137.25) + 3(144)

= 549 + 432

= 981 sq. in of framing

TOTAL AREA:

(96 × 96)

= 9216 sq. in

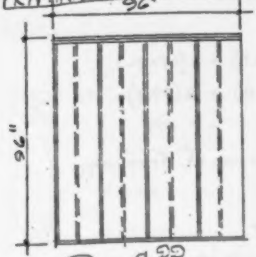
NET INSULATED = 9216−981 = 8235 sq. in.

THEREFORE:

$\frac{981}{9216}$ = 11% wood

$\frac{8235}{9216}$ = 89% insulation

= CALCULATED R VALUES
FRAMING CORRECTION FACTORS - CONT.



24 O.C.
STAGGERED
(DOUBLE WALL)

PLATE AREAS

$3(1.5 \times 96)$

$= 432$ SQ. IN. PLATES (CONTINUOUS THROUGH WALL)

EXTERIOR STUD AREAS

$4(1.5 \times 91.5) = 549$ SQ. IN.

INTERIOR STUD AREAS

$4(1.5 \times 91.5) = 549$ SQ. IN.

TOTAL AREA

(96×96)

$= 9216$ SQ. IN.

NET INSULATED

$9216 - 432 - 549 - 549 = 7686$ SQ. IN. INSUL CONTINUOUS THROUGH WALL

THEREFORE:

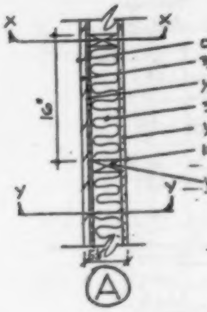
$\frac{432}{9216} \doteq 5\%$ PLATE

$\frac{549}{9216} \doteq 6\%$ EXTERIOR STUDS

$\frac{549}{9216} \doteq 6\%$ INTERIOR STUDS

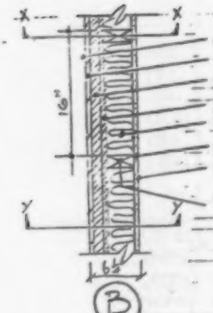
$\frac{7686}{9216} \doteq 83\%$ INSULATION

[illegible]



A

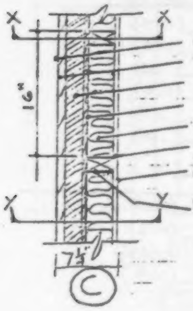
	SECTION XX (THROUGH FRAMING)	SECTION YY (THROUGH BATTS)
OUTSIDE FILM(3)	(.25)	(.25)
3/4" WOOD SIDING(4)	(1.05)	(1.05)
1/2" PLY SHEATHING(5)	(.62)	(.62)
3 1/2" FIBERGLAS BATT	(—)	(11.0)
1/2" SHEETROCK	(.45)	(.45)
INSIDE FILM	(.68)	(.68)
WOOD FRAMING	(4.35)	(—)
"R"T OF FLOW PATH	(7.4)	(14.05)
"U" OF FLOW PATH	(.1351)	(.0712)
FRAMING CORRECTION(7)	(x14%)	(x86%)
	(.0189) +	(.0612)
"U" OF WALL SECTION	(.0801)	
"R" OF WALL SECTION	(12.49)	



B

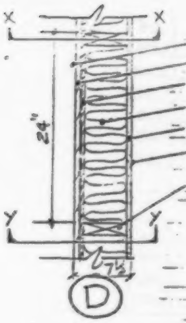
	SECTION XX (THROUGH FRAMING)	SECTION YY (THROUGH BATTS)
OUTSIDE FILM(3)	(.25)	(.25)
3/4" WOOD SIDING(4)	(1.05)	(1.05)
1" RIGID STYROFOAM(6)	(5.00)	(5.00)
1/2" PLY SHEATHING(5)	(.62)	(.62)
3 1/2" FIBERGLAS BATT	(—)	(11.0)
1/2" SHEETROCK	(.45)	(.45)
INSIDE FILM	(.68)	(.68)
WOOD FRAMING	(4.35)	(—)
"R"T OF FLOW PATH	(12.40)	(19.05)
"U" OF FLOW PATH	(.0806)	(.0525)
FRAMING CORRECTION(7)	(x14%)	(x86%)
	(.0113) +	(.0451)
"U" OF WALL SECTION	(.0564)	
"R" OF WALL SECTION	(17.73)	

[illegible]



	SECTION: XX THROUGH FRAMING	YY THROUGH BATTS
OUTSIDE FILM[2]	(.25)	(.25)
¾" WOOD SIDING[4]	(1.05)	(1.05)
2" RIGID STYROFOAM[4]	(10.0)	(10.0)
½" PLY SHEATHING[3]	(.62)	(.62)
3½" FIBERGLAS BATT	(—)	(11.0)
½" SHEETROCK	(.45)	(.45)
INSIDE FILM	(.68)	(.68)
WOOD FRAMING	(4.35)	(—)
"R_T" OF FLOW PATH	(17.4)	(24.05)
"U" OF FLOW PATH	(.0375)	(.0416)
FRAMING CORRECTION[1]	(x14%)	(x86%)
	(.0080) +	(.0358)

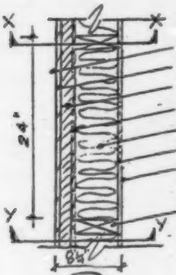
"U" OF WALL SECTION: (.0438)
"R" OF WALL SECTION: (22.85)



OUTSIDE FILM[2]	(.25)	(.25)
¾" WOOD SIDING[4]	(1.05)	(1.05)
½" PLY SHEATHING[3]	(.62)	(.62)
5½" FIBERGLAS BATT	(—)	(19.0)
½" SHEETROCK	(.45)	(.45)
INSIDE FILM	(.68)	(.68)
WOOD FRAMING	(6.88)	(—)
"R_T" OF FLOW PATH	(9.93)	(22.05)
"U" OF FLOW PATH	(.1007)	(.0454)
FRAMING CORRECTION[1]	(x 11%)	(x89%)
	(.0111) +	(.0404)

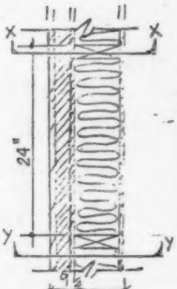
"U" OF WALL SECTION (.0515)
"R" OF WALL SECTION (19.42)

CALCULATED 'R' VALUES
PARALLEL HEAT FLOW(1,2)



E

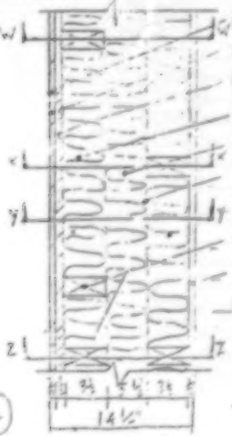
	SECTION XX THROUGH FRAMING	YY THROUGH BATTS
OUTSIDE FILM(1)	(.25)	(.25)
3/4" WOOD SIDING(4)	(1.05)	(1.05)
1" RIGID STYROFOAM(4)	(5.00)	(5.00)
1/2" PLY SHEATHING(5)	(.62)	(.62)
5½" FIBERGLAS BATT	(—)	(19.0)
1/2" SHEETROCK	(.45)	(.45)
INSIDE FILM	(.68)	(.68)
WOOD FRAMING	(6.88)	(—)
"R_T" OF FLOW PATH	(14.93)	(27.05)
"U" OF FLOW PATH	(.0670)	(.0370)
FRAMING CORRECTION(7)	(11%)	(89%)
	(.0074) +	(.0329)
"U" OF WALL SECTION	(.0403)	
"R" OF WALL SECTION	(24.83)	



F

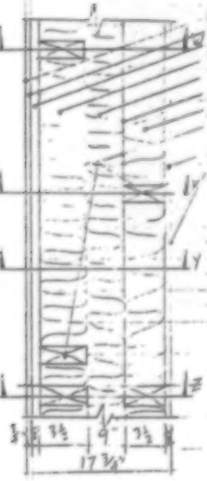
OUTSIDE FILM(1)	(.25)	(.25)
3/4" WOOD SIDING(4)	(1.05)	(1.05)
2" RIGID STYROFOAM(4)	(10.00)	(10.00)
1/2" PLY SHEATHING(5)	(.62)	(.62)
5½" FIBERGLAS BATT	(—)	(19.0)
1/2" SHEETROCK	(.45)	(.45)
INSIDE FILM	(.68)	(.68)
WOOD FRAMING	(6.88)	(—)
"R_T" OF FLOW PATH	(19.93)	(32.05)
"U" OF FLOW PATH	(.0502)	(.0312)
FRAMING CORRECTION(7)	(×11%)	(×89%)
	(.0055) +	(.0278)
"U" OF WALL SECTION	(.0333)	
"R" OF WALL SECTION	(30.03)	

[illegible]



(G)

	W W THROUGH INT. STUDS	X X THROUGH INT. STUDS	Y Y THROUGH INSULATION	Z Z THROUGH PLATES
OUTSIDE FILM(a)	(.25)	(.25)	(.25)	(.25)
5/8" WOOD SIDING(a)	(1.05)	(1.05)	(1.05)	(1.05)
1/2" PLY SHEATHING(b)	(.62)	(.62)	(.62)	(.62)
3 1/2" FIBERGLASS BATT	(—)	(11.0)	(11.0)	—
5 1/2" FIBERGLASS BATT	(19.0)	(19.0)	(19.0)	(19.0
VAPOR BARRIER (6 MIL)	(—)	(—)	(—)	(—
3 1/2" FIBERGLASS BATT	(11.0)	(—)	(11.0)	(—
3 1/2" WOOD STUD, PLATES	(4.35)	(4.35)	(—)	(8.7
1/2" SHEETROCK	(.45)	(.45)	(.45)	(.45
INSIDE FILM	(.68)	(.68)	(.68)	(.68
"R" OF FLOW PATH	37.4	37.4	44.05	30.75
"U" OF FLOW PATH	.027	.027	.023	.033
FRAMING PERCENTAGES(h)	6% .00162 +	6% .00162 +	83% .0191 +	5% .001[illegible]
"U" OF WALL SECTION			.02[illegible]	
"R" OF WALL SECTION			41.67	



(H)

	WW THROUGH STUDS	XX THROUGH INT. STUDS	YY THROUGH INSULATION	ZZ THROUGH PLATES
OUTSIDE FILM(a)	(.25)	(.25)	(.25)	(.25
5/8" WOOD SIDING(a)	(1.05)	(1.05)	(1.05)	(1.05)
1/2" PLY SHEATHING(b)	(.62)	(.62)	(.62)	(.62)
3 1/2" FIBERGLASS BATT	(—)	(11.0)	(11.0)	(—
9" FIBERGLASS BATT	(30.0)	(30.0)	(30.0)	(30.0
6 MIL VAPOR BARRIER	(—)	(—)	(—)	(—
3 1/2" FIBERGLASS BATT	(11.0)	(—)	(11.0)	(—
3 1/2" WOOD STUD, PLATES	(4.35)	(4.35)	(—)	(8.7
1/2" SHEET ROCK	(.45)	(.45)	(.45)	(.45)
INSIDE FILM	(.68)	(.68)	(.68)	(.68)
R OF FLOW PATH	48.4	48.4	55.05	41.75
U OF FLOW PATH	.02066	.02066	.01817	.023[illegible]
FRAMING PERCENTAGES(h)	6% .00124 +	6% .00124 +	83% .01508 +	5% .0011
"U" OF WALL SECTION			.01876	
"R" OF WALL SECTION			53.31	

WALL SECTION COSTS[8]

Wall Section	Wood Siding [9]	1" rigid insul. R-5 [10]	2" rigid insul R-10 [10]	Plywood Sheathing [11]	Fiberglass Batt, R-11 [12]	Framing [13]	Fiberglass Batt, R-19 or 30 [12]	3½" Fiberglass Batt, R-11 [12]	Sheetrock [14]	Mark-up [15]	Total
A. Materials	.92	--	--	.35	.15	.40	--	--	.15	--	--
Labor	.45	--	--	.32	.09	.41	--	--	.24	--	--
Total	1.37	--	--	.67	.24	.81	--	--	.39	.87	4.35
B. Materials	.92	.25	--	.35	.15	.40	--	--	.15	--	--
Labor	.45	.15	--	.32	.09	.41	--	--	.24	--	--
Total	1.37	.40	--	.67	.24	.81	--	--	.39	.97	4.85
C. Materials	.92	--	.50	.35	.15	.40	--	--	.15	--	--
Labor	.45	--	.15	.32	.09	.41	--	--	.24	--	--
Total	1.37	--	.65	.67	.24	.81	--	--	.39	1.03	5.16
D. Materials	.92	--	--	.35	.25	.61	--	--	.15	--	--
Labor	.45	--	--	.32	.13	.54	--	--	.24	--	--
Total	1.37	--	--	.67	.38	1.15	--	--	.39	.99	4.95
E. Materials	.92	.25	--	.35	.25	.61	--	--	.15	--	--
Labor	.45	.15	--	.32	.13	.54	--	--	.24	--	--
Total	1.37	.40	--	.67	.38	1.15	--	--	.39	1.09	5.45
F. Materials	.92	--	.50	.35	.25	.61	--	--	.15	--	--
Labor	.45	--	.15	.32	.13	.54	--	--	.24	--	--
Total	1.37	--	.65	.67	.38	1.15	--	--	.39	1.15	5.76
G. Materials	.92	--	--	.35	.15	.72	--	--	.15	--	--
Labor	.46	--	--	.32	.09	.76	--	--	.24	--	--
Total	1.37	--	--	.67	.24	1.48	.38	.24	.39	1.19	5.96
H. Materials	.92	--	--	.35	.15	.72	--	--	.15	--	--
Labor	.45	--	--	.32	.09	.76	--	--	.24	--	--
Total	1.37	--	--	.67	.24	1.48	.53	.24	.39	1.23	6.15

NOTES:

1) All wall component "R" values and calculations are from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals (1977).
2) All heat flows are assumed to be perpendicular to the plane of the wall (parallel heat flow). Series-Parallel calculations (see ASHRAE) are not appropriate for these materials and conditions.
3) ASHRAE 7½ MPH coefficient used to approximate average yearly wind speed coefficient.
4) Siding is 3/4" X 10" bevel, lapped.
5) Sheathing is ½" thick douglas fir plywood.
6) Rigid insulation is 2.2 lb/ft^3 extruded smooth skin styrofoam.
7) Computed on page 2 or 3.
8) All costs (except as noted) from National Construction Estimator (N.C.E.), 1979.
9) N.C.E., page 93.
10) N.C.E., page 74, Labor for 3/4" board used, material corrected to specified thickness at same unit cost.
11) N.C.E., page 194, CD, rough, ½".
12) N.C.E., page 74, Kraft paper-faced.
13) N.C.E., page 20.
14) N.C.E., pages 211, 65, 66, values used assumed from combining data on these pages.
15) N.C.E., page 96, covers contractor's markup.

APPENDIX III:

ISSUES RELATING TO INDOOR AIR QUALITY

Prepared by:

Consumer Energy Council of America

April 1980

APPENDIX III

ISSUES RELATING TO INDOOR AIR QUALITY

A. Introduction

The potential danger that low infiltration rates pose to the health and safety of building occupants is a matter of considerable concern to the consumer. A great deal of research in this highly complex area remains to be done, yet the trend toward ever tighter buildings continues apace. The following discussion of specific pollutants and other factors associated with low infiltration rates is intended to highlight the potential problems which could result from various energy conservation measures.

B. Specific Pollutants

1. Carbon monoxide

Extensive research has documented that carbon monoxide (CO) is one of the more potent contaminants present in the indoor environment, posing a grave danger to human health, particularly to the cardiovascular system and the brain. Outside air, automobile emissions, gas stoves, improperly vented oil and gas furnaces and cigarette smoking are major contributors to high concentrations of carbon monoxide.

Occupant behavior at different times of day directly affects the levels of carbon monoxide present in a building. CO levels measured by Lawrence Berkeley Labs in residential structures were frequently found to exceed ambient air levels, especially when released from a gas oven set at

350 degrees for one hour. This oven condition produced levels of CO that exceeded the one hour national ambient air quality standard (35 ppm) at a "tight" air exchange rate of 0.24. The eight hour air quality standard (9 ppm) was exceeded under the same operating conditions at an air exchange rate of 2.5. 1/

The health impacts of exceedingly high levels of carbon monoxide range from headaches and dizziness at lower concentrations to vomiting and asphyxiation at higher concentrations. In extreme cases (concentrations over 1000 ppm), death may result. The greatest danger from CO lies in its affinity for the hemoglobin molecule, which is normally oxygen-enriched and transports vital oxygen via the bloodstream to body tissues. Carbon monoxide binds to the hemoglobin molecule, displacing vital oxygen binding and therefore depriving the brain, heart and lungs of life supporting oxygen.

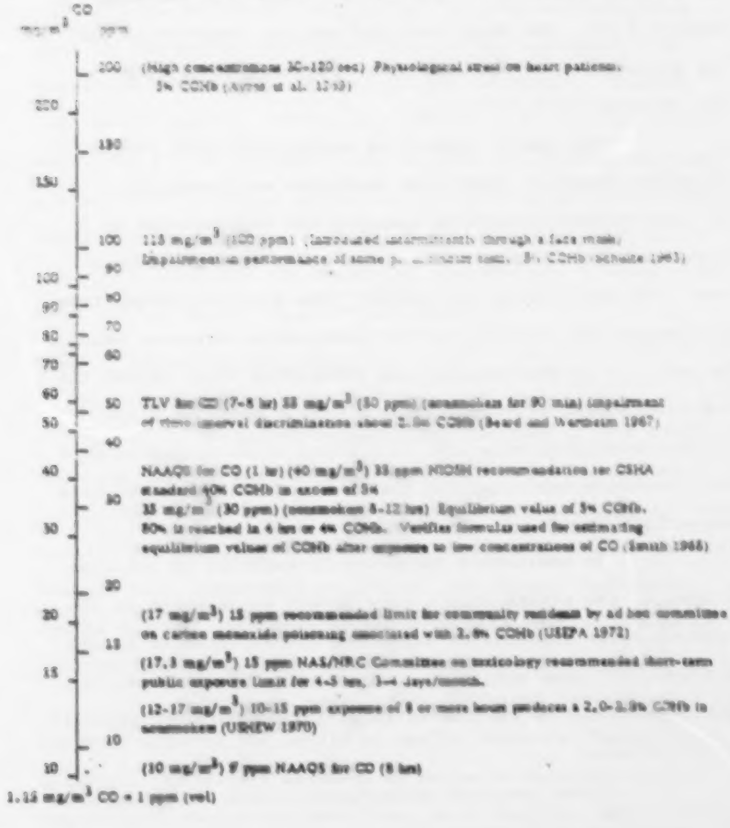
To ameliorate dangerous CO exposure to building occupants, gas stoves should have direct ventilation to the outdoors. Gas furnaces or any other gas applicances should be turned off when not in use. Smoking areas in commercial buildings should be restricted to minimize exposure, especially to non-smokers.

Carbon monoxide concentrations and health impacts are summarized in Figure A-III-1.

1/ C.D. Hollowell and G.W. Traynor, "Combustion-Generated Indoor Air Pollution" (Lawrence Berkeley Laboratory, Berkeley, CA, April, 1978) p. 7; Hereafter referred to as "Combustion-Generated Indoor Air Pollution."

FIGURE A-III-1

REFERENCE DATA FOR EFFECTS OF CARBON MONOXIDE EXPOSURES



(High concentrations 30-120 sec) Physiological stress on heart patients. 3% COHb (Ayres et al. 1970)

115 mg/m³ (100 ppm) (Introduced intermittently through a face mask) Impairment in performance of some psychomotor tests. 5% COHb (Schulte 1963)

TLV for CO (7-8 hr) 55 mg/m³ (50 ppm) (nonsmokers for 90 min) impairment of time interval discrimination about 2.5% COHb (Beard and Wertheim 1967)

NAAQS for CO (1 hr) (40 mg/m³) 35 ppm NIOSH recommendation for OSHA standard 40% COHb in excess of 5%

35 mg/m³ (30 ppm) (nonsmokers 8-12 hrs) Equilibrium value of 5% COHb. 80% is reached in 4 hrs or 4% COHb. Verifies formulas used for estimating equilibrium values of COHb after exposure to low concentrations of CO (Smith 1968)

(17 mg/m³) 15 ppm recommended limit for community residents by ad hoc committee on carbon monoxide poisoning associated with 2.4% COHb (USEPA 1972)

(17.3 mg/m³) 15 ppm NAS/NRC Committee on toxicology recommended short-term public exposure limit for 4-5 hrs, 3-4 days/month.

(12-17 mg/m³) 10-15 ppm exposure of 8 or more hours produces a 2.0-2.5% COHb in nonsmokers (USHEW 1970)

(10 mg/m³) 9 ppm NAAQS for CO (8 hrs)

1.15 mg/m³ CO = 1 ppm (vol)

Source:

GEOMET, Inc., "Survey of Indoor Air Quality Health Criteria and Standards", Prepared for Environmental Monitoring and Support Lab, Research Triangle Park, NC, March 1978, p. 77.

2. Carbon dioxide

Both household combustion processes and building occupants produce carbon dioxide (CO_2). Occupant density and activity directly influence CO_2 concentrations. In commercial or educational facilities where there are large numbers of people, "carbon dioxide may be the most important parameter for determining ventilation rates."[2]

The average NAAQS level set for CO_2 is 325 ppm, but may vary from 100 to 500 ppm. This is compared to indoor concentrations of between 150 and 220 ppm based on hourly averages.[3]

Carbon dioxide exposure is generally not considered to be extremely dangerous although excessively high industrial exposures have caused some fatalities. Physiological reactions to CO_2 exposure are similar to symptoms of oxygen deprivation. "Carbon dioxide has been reported to be a weak narcotic at 30,000 ppm ... at 50,000 ppm, a 30 minute exposure produces signs of intoxication and at 70,000 to 100,000 ppm, unconsciousness in a few minutes."[4]

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[2] James V. Berk, C.D. Hollowell, Chin-I Lin, "Indoor Air Quality Measurements in Energy-Efficient Houses" (Lawrence Berkeley Laboratory, Berkeley, CA, July 1979) p. 13.

[3] Health Criteria and Standards, p. 78.

[4] Health Criteria and Standards, p. 78.

3. Sulfur dioxide

Combustion products from heating and cooling appliances contribute to sulfur dioxide (SO_2) concentrations as well as to sulfate levels. Chemical reactions occurring in the ambient air or upon physical contact with certain surfaces converts SO_2 to sulfate ion (SO_4). These substances are usually present in the atmosphere as fine suspended particulate matter less than 2 micrometers in size, and as much as 80 percent may not be effectively filtered out by the respiratory tract. Sulfates, therefore, often pose a greater health risk than SO_2. Winkelstein and Gay (1971) found a stronger correlation between SO_2 particulates and respiratory and cardiovascular disease than when SO_2 alone was present. 5/

Numerous studies have documented the association of SO_2 with suspended particulates as causing an increased incidence of serious diseases. Heightened levels of SO_2 and sulfates have been implicated in causing an increased incidence of respiratory, gastrointestinal and urealogical cancers. 6/ Oddly enough, no correlation was found between increased cancers and exposure to SO_2 alone. Higher mortality rates due to respira-

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5/ Health Criteria and Standards, p. 70.

6/ Health Criteria and Standards, p. 70.

tory and cardiovascular disease have been observed by Winkelstein and Gay (1971). Again, the association of SO_2 with particulate matter was the causal factor.[7]

"The association of longer term sulfur dioxide concentrations with various forms of respiratory morbidity led to the setting of the annual standards of 80 micrograms per cubic meter (ug/m^3) (or 0.03 ppm)." [8] The 24 hour NAAQS level is 365 ug/m^3 (0.14 ppm); the 3 hour threshold limit value is 1300 ug/m^3 (0.05 ppm).[9] Sulfur dioxide irritant effects threshold limits are set between 1600 and 2600 ug/m .[10] Generally speaking, indoor concentrations of SO_2 do not exceed outdoor levels. Sulfur dioxide is a reactive substance and has the capacity for rapid self-depletion. What is a cause for concern, however, are the conversion products of SO_2 which may persist in the indoor atmosphere at levels approximating ambient concentrations. Children, the elderly and the infirm may sustain deleterious health effects resulting from prolonged exposures even to low concentrations (8-10 um/m^3) of sulfur dioxides.

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[7] *Health Criteria and Standards*, p. 70.

[8] *Health Criteria and Standards*, p. 69.

[9] *Environmental Quality - 1979: The Tenth Annual Report of the Council on Environmental Quality* (Washington, D.C.) p. 54.

[10] *Health Criteria and Standards*, p. 69.

Sulfur dioxide concentrations and health impacts are summarized in Figure A-III-2.

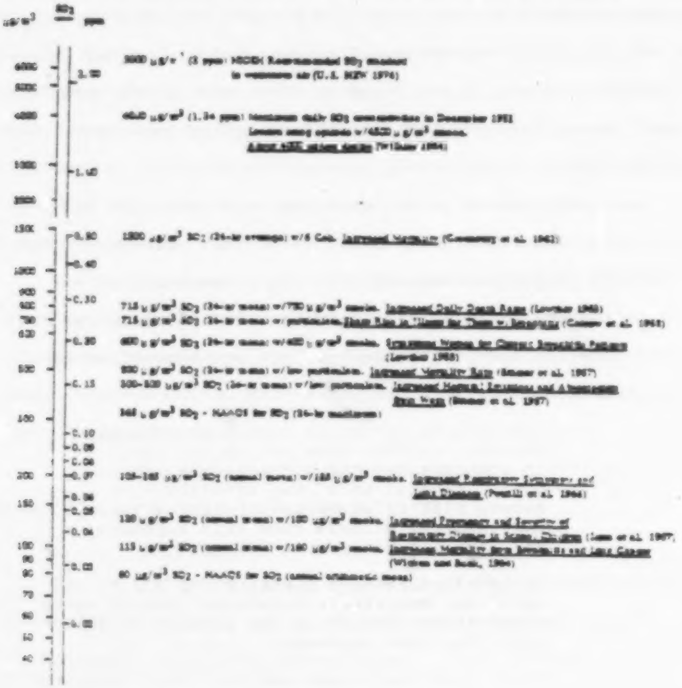
4. Nitrogen oxides

Concentrations of nitrogen compounds are generated from both outdoor and indoor sources, the latter including tobacco smoke and gas-fired heating and cooking equipment. A recent study found that indoor/outdoor levels of nitrogen oxides were generally equal. But, depending upon furnace use and cooking activity, nitrogen dioxide (NO_2) concentrations may substantially exceed ambient levels. Hollowell and Traynor of Lawrence Berkeley Labs studied the relationship between air exchange rates and NO_2 levels with a gas stove operating at 350 degrees for one hour. 11/ The recommended national ambient one hour air quality standard (0.2-0.5) was exceeded (.63) at 2.5 air changes per hour. Further reductions in ventilation rates produced sharp increases in NO_x concentrations.

11/ "Combustion-Generated Indoor Air Pollution," p. 7.

FIGURE A-III-2

REFERENCE DATA FOR EFFECTS OF SULFUR DIOXIDE EXPOSURES



Source:

GEOMET, Inc., "Survey of Indoor Air Quality Health Criteria and Standards," Prepared for Environmental Monitoring and Support Lab, Research Triangle Park, NC, March 1978, p. 66.

Peak average concentrations of 450 and 950 ug/m^3 during gas stove operation have been recorded over an hour's time by Eaton et al. (1973) and Hollowell et al. (1976). Higher concentrations (up to 1.0-1.5 ppm or 1900-2800 ug/m^3) were measured during less than an hour's time by the same researchers.[12]

High levels of NO_2 generally are temporary conditions because of the reactive nature of NO_2. However, intermediate substances derived from NO_2 present a risk to health in the form of nitrates, nitrites and nitrosamines. Impacts on health from NO_x concentrations are summarized by GEOMET, Inc. as follows:

1. Exposure to prolonged levels of nitrogen dioxide, ranging from 113 to 395 ug/m^3, in combination with short-term exposure of 301 to 1203 ug/m^3, may contribute to excess risk of acute respiratory disease. The residual effects from this exposure may last for as long as four years.
2. Repeated short-term exposures of 228 to 815 ug/m^3 may contribute to excess risk of acute respiratory disease in the absence of excessive long-term exposure.
3. Prior high short-term and long-term exposures of NO_2, coupled with continous excessive short-term exposures, might trigger the onset of chronic respiratory disease symptoms.[13]

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[12] Health Criteria and Standards, p. 82.

[13] Health Criteria and Standards, pp. 80-81.

The high incidence of respiratory disease from NO_x exposure results because NO_2 is fairly insoluble, is not easily filtered by the respiratory system and thus is able to penetrate deeply into the lungs and have its primary effect upon the pulmonary capillaries. Higher mortality rates from hypertension and arteriosclerotic heart disease have been linked to NO_2 inhalation and ingestion. Nitrosamines are suspected carcinogens of the stomach and intestine.

Digestion converts ingested nitrates to nitrites which may cause nitrate poisoning.14/ Nitrate poisoning (cyanosis) inhibits an oxygen-transporting mechanism in the blood, methemoglobin, from supplying body tissues with an adequate blood supply.

Nitrogen dioxide concentrations and health impacts are summarized in Figure A-III-3.

5. Particulates

Concentrations and impacts of indoor particulate matter is difficult to quantify and qualify due to insufficient research on indoor particulates. This difficulty is

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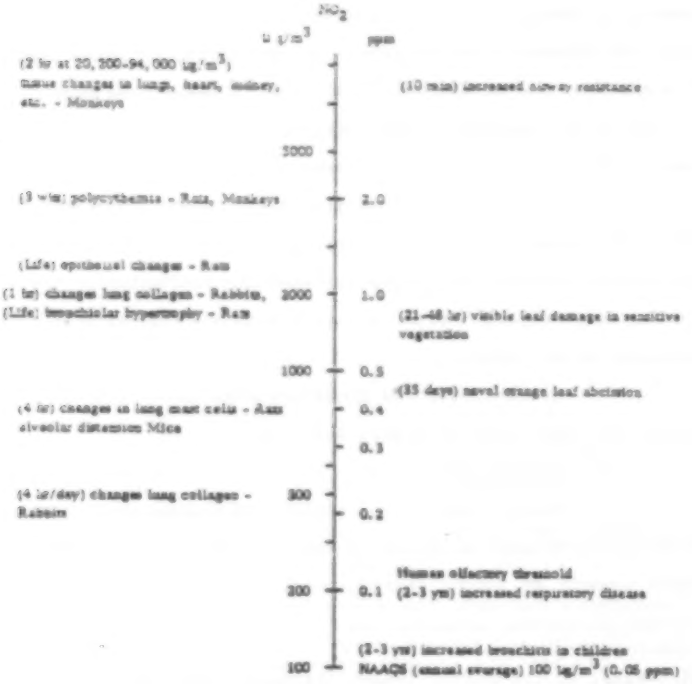
14/ Final Environmental Impact Statement, Residential Conservation Service Program (Department of Energy, Washington, D.C., November 1979) p. 3-117; Hereafter referred to as FEIS/DOE.

FIGURE A-III-3

REFERENCE DATA FOR EFFECTS OF NITROGEN DIOXIDE EXPOSURES



Source:

GEOMET, Inc., "Survey of Indoor Air Quality Health Criteria and Standards," Prepared for Environmental Monitoring and Support Lab, Research Triangle Park, NC, March 1978, p. 79.

compounded by the fact that much particulate matter consists of gas components from household aerosols which may be neither readily detectable physically by the senses nor detectable physiologically. Pathological manifestations may not appear until many years later.

Research has not been able to keep pace with the number of new products available to the public which may not have been thoroughly examined for toxicological hazards. Primary ambient sources include power plants, automobile exhausts, pollen and dust. Smoking, gas appliances and household cleaning agents are major sources of indoor particulates. Certain insulation as well as heat exchangers contributes aesbestos particles to the air.

Indoor particulate levels vary greatly depending upon household activity, concentrations of outdoor particulates and infiltration of particles into structures. Infiltration is heavily dependent upon particle size. Larger particles may be effectively screened out, whereas easily respirable smaller particles may reach indoor concentrations that far surpass recommended primary 24 hour ambient total suspended particulate (TSP) levels of 260 ug/m^3. Physical and chemical properties will influence disease manifestations resulting from inhalation of particulates. The size and aerodynamic properties affect the extent of deposition within the lungs. Solubility and size determine how long particulate matter may remain inside pulmonary tissue. Chemical composition will affect the effectiveness of clearance mechanisms in the blood. Lastly, particulate toxicity may be influenced by one or all of the above factors.

Particulates have been connected with pulmonary, respiratory and cardiovascular problems. Again, severity of these illnesses is related to particle size, shape and density. Tobacco smoke contains carcinogens and cocarcinogens which are responsible for increasing the risk of cancer as well as the problems mentioned above. More recent research has concentrated upon the exposure of non-smokers to tobacco smoke. Common afflictions to such exposure include eye irritation, chronic respiratory symptoms, elevated carboxyhemoglobin and nicotine levels.

In the final analysis, observed health effects related to NAAQS levels may be evidenced at lower levels indoors because of the higher concentrations of respirable particulates present. Special precautions must be taken to mitigate lethal particulate concentration levels in the indoor environment.

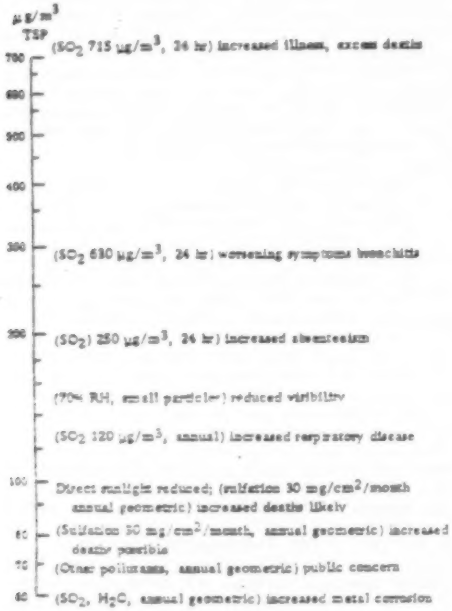
Particulate concentrations and health impacts are summarized in Figure A-III-4.

6. Hydrocarbons

Hydrocarbons are found in the atmosphere in several forms -- as photochemical oxidants, aldehydes, non-methane hydrocarbons, aromatic and chlorinated hydrocarbons. Car

FIGURE A-III-4

REFERENCE DATA FOR HEALTH EFFECTS OF PARTICULATE EXPOSURES



Source:

GEOMET, Inc., "Survey of Indoor Air Quality Health Criteria and Standards," Prepared for Environmental Monitoring and Support Lab, Research Triangle Park, NC, March 1978, p. 101.

exhaust is the primary outdoor contributor. Pesticides and insecticides contribute as well. Many types of household cleaning solvents, spray can propellants, chemical agents (paint removers and thinners, lacquers, shellacs, wax polishes), laundry products, cooking and heating activities and systems, smoking and some building materials are among the many sources of indoor hydrocarbons.

Known health effects of hydrocarbons are based on studies conducted in the industrial environment, so that conclusions applied to the impacts for nonworkplace situations must be regarded as somewhat arbitrary. "Safe" levels for industrial exposures are too high for safe indoor levels. Further, health effects reflect only short term exposures.

Hydrocarbons can be detrimental if present in high concentrations over the short term or low concentrations over the long term. Saturated aliphatic hydrocarbons, particularly propane through octane, have increasingly strong narcotic properties. High concentrations of aromatic hydrocarbons -- benzene, toluene, xylene, for example -- cause severe poisoning resulting from a suppressive effect on the central nervous system. Myeloid leukemia may be linked to low concentrations of benzene. Chlorinated hydrocarbons in household cleaning solvents and paint products are extremely volatile and manifest themselves in a general narcosis over the short term at relatively high concentrations. Eye and respiratory irritation, liver, heart and kidney damage can occur.

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Alcohols, ketones, ethers, esthers, acids and caustics may also cause eye and respiratory irritation, but the noted effects have generally not been severe unless the contaminants exist in very high concentrations. Fluorocarbons from aerosol sprays may exacerbate respiratory and cardiovascular problems at high concentrations.

Aldehyde exposure/response studies have concentrated most heavily upon formaldehyde. Formaldehyde is emitted from some insulating materials (urea-formaldehyde foam insulation), building materials (plywood, particle board), as well as textiles and adhesives used in furniture and clothing. Urea-formaldehyde foam insulation is mainly used in retrofit applications although it is gaining more popularity for use in new construction. Formaldehyde gas contained in the urea-formaldehyde based resin is discharged into the air during the foaming operation and after injection into the wall cavity. Gas inhalation can lead to eye and upper respiratory mucous membrane irritation, skin rashes, nasal congestion and shortness of breath. Concentrated doses "can lead to pulmonary edema (an acute respiratory irritation), pneumonitis, and in extreme cases, death."[15]

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[15] FEIS/DOE, pp. 3-71.

The gas may be detectable by some individuals at concentrations as low as .05 ppm, but harmful effects may occur at lower concentrations, depending upon the systemic sensitivity of the individual.

Violations of both European and NAAQS levels for formaldehyde are frequent in recently-constructed mobile homes because plywood and similar building materials are extensively used in their construction. Formaldehyde is suspected of having a carcinogenic effect upon the lungs, but further research is necessary to substantiate this claim concretely. Generally speaking, formaldehydes will irritate the eyes and respiratory mucous membranes at concentrations ranging between .01 ppm and 1.0 ppm. They are also known to "induce hypersensitivity and to depress ciliary activity."[16]

The health hazards posed by aldehyde/formaldehyde exposure can be partially mitigated by the enforcement of stringent materials' standards that would put a check on the percentage of formaldehyde in the resin. Use of a formaldehyde absorbent paint on walls can help reduce formaldehyde levels in the air.

The interaction of NO_x and automobile-generated hydrocarbons with sunlight form the secondary pollutants known as ozone and PAN (peroxyacetyl nitrate). These photochemical oxidants are both extremely reactive and dissipate in the air or are otherwise absorbed on indoor surfaces very quickly. Even though ozone and PAN occur in low concentrations, the importance of these pollutants should not be too easily dismissed. No research has been conducted to determine health hazards from the cumulative effects of repeated exposures. The potential risk may be greater than presently assumed because many ozone sources are from households or industrial products commonly used at near toxic levels.

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[16] Health Criteria and Standards, p. 87.

Hydrocarbon and photochemical concentrations and health impacts are summarized in Figures A-III-5 and A-III-6.

7. Radon

Radon is an inert, radioactive gas that results from the decay of uranium-238. The decay daughters are not inert, however, and eventually form lead 210, which is capable of causing severe lung damage.

Any material containing radium-226, the precursor of radon-222, may be a potential emanation source. Typically, radium-226 is a trace element in soil and rock. Building materials such as concrete and brick, the soil or rock underneath building foundations, or water drawn from wells or springs near radium-containing earth all contribute to indoor concentrations of radon.

The health danger from radon is caused by the decay of the radon daughters. They attach themselves by chemical or physical means to respirable airborne particles which serve

FIGURE A-III-5

HYDROCARBONS

ILLUSTRATIVE HEALTH INFORMATION ON SOME HOUSEHOLD SOLVENTS AND CLEANERS

Compound	Use	TLV*	Exposure-Response Data*
Methylene chloride	Paint remover	200 ppm (720 mg/m³)	180-200 ppm per day results in increment of 4.5 percent COHb. Narcosis above 4,000 ppm. Brain damage reported from repeated peaks above 500 ppm.
Perchlorethylene	Cleaning fluid	100 ppm (670 mg/m³)	100 ppm for 7 hours produced narcotic effect, headache, mild eye and respiratory irritation. Marked narcotic effect above 200 ppm for 2 hours.
VM&P Naphtha	Paint thinner	200 ppm (900 mg/m³)	Multiple hydrocarbon content (TLV based on benzene, xylene).
enzol (benzene) Toluol (toluene) Xylol (xylene)	Lacquer and cement solvents	10 ppm (30 mg/m³)-Skin	Myelotoxicant. Skin absorption can produce chronic poisoning. Headache, nausea, narcosis above 200 ppm. May contain benzene 200 ppm irritating. GI, neurological and vascular effects reported in workers. May contain 6-12 percent ethyl benzene.
Methanol	Shellac and varnish thinner	200 ppm (260 mg/m³)-Skin	No worker injury at average 160-780 ppm. Repeated exposure above 3,000 ppm may result in cumulative body concentration.
cetone	Lacquer solvent	1000 ppm (2400 mg/m³)	Minor eye and nose irritation above 2500 ppm.
hyl ether	Lacquer, wax, plastic solvent	400 ppm (1200 mg/m³)	Nasal irritation above 200 ppm. No worker injury demonstrated from regular exposure of 500-1000 ppm. Chronic effects noted after long-term exposure.
odium hydroxide	Drain cleaner	2 mg/m³	Upper respiratory irritant at 2 mg/m³.
Ammonia	Window cleaner	25 ppm (18 mg/m³)	Rat ciliary motion stopped at 3 ppm. Detection at 1-5 ppm. Eye and nasal irritation at 20-25 ppm.
urpentine	Painting	100 ppm (560 mg/m³)	Respiratory irritation at 75 ppm. Marked irritation and nausea occur above 750 ppm for several hours.

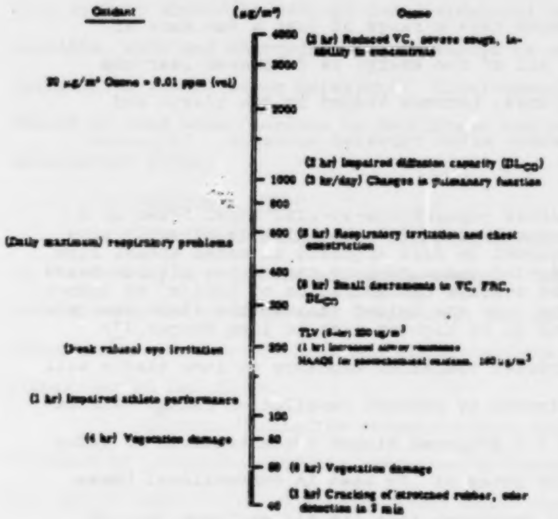
* TLV's and Response Data from Documentation of the Threshold Limit Values (1974)

Source:

GEOMET, Inc., "Survey of Indoor Air Quality Health Criteria and Standards," Prepared for Environmental Monitoring and Support Lab, Research Triangle Park, NC, March 1978, p. 90.

FIGURE A-III-6

REFERENCE DATA FOR HEALTH EFFECTS OF PHOTOCHEMICAL OXIDANT EXPOSURES



Reference data for health effects of photochemical oxidant exposure.

Source:

GEOMET, Inc., "Survey of Indoor Air Quality Health Criteria and Standards," Prepared for Environmental Monitoring and Support Lab, Research Triangle Park, NC, March 1978, p. 85.

as transportation mechanisms into the lungs. The radon daughters continue to decay via alpha emissions forming such harmful intermediate substances as polonium 213-214, that ultimately decay further to form lead-210. Because the alpha particles have a range of just a few tens of microns, nearly all of the energy is delivered near the surface of the lungs, becomes lodged in the tissue and causes tissue damage after repeated exposure. According to one report:

> A simple populations-at-risk model based on a "linear hypothesis" that risk is directly proportional to dose suggests an added annual risk of 40-300 cases of lung cancer per million based on an average concentration of $1 nCi/m^3$ of indoor radon. In the United States, the 45-64 year age group is at highest risk to lung cancer.[17]

Increased radiation exposure to lung tissue will certainly be affected by reduced ventilation rates. Air exchange rates of 0.3 produced higher concentrations of radon than air exchange rates of .75 used in conventional homes. One recent study concluded that, "An air exchange rate of approximately 0.5 ach is required in order to maintain radon concentrations below 4 nCi/m^3, the maximum permissible concentration given by health guidelines."[18] This figure is based on a worst case estimate.

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[17] IECBH, p. 7.

[18] IECBH, p. 7.

Since indoor radon levels are strongly affected by the way building materials are incorporated into the structure, mitigating measures should certainly include the careful selection of materials during the design phase. Mechanical HVAC systems should be adopted for residential use. Where possible, wall and concrete surfaces should be coated with sealants to reduce radon emissions. Crawl-space ventilation should be used when feasible to facilitate and improve radon dissipation rates.

8. Fire and Smoke

The final concern in reducing ventilation rates is the risk of fire spread and smoke damage. Reduced rates, coupled with use of increased insulation, may drastically alter smoke and fire movement and concentrations of toxic properties in buildings.

Certain insulation materials emit toxic substances produced by pyrolysis products contained in smoke. Neither the way in which these substances react under varying fire conditions, nor the quality of smoke they produce is well understood. Thus far, test results and conclusions regarding toxicity, fire spread, and subsequent impacts on human health reflect rigid laboratory simulations. Testing methods must be devised that will quantify flammability rates and qualify smoke evolution under actual fire conditions.

Some fire dangers posed by insulation are as follows: (1) Organic and mineral-fiber-loose-fill-insulation may ignite if located in too close proximity to recessed ceiling lights or electrical wiring. (2) Uninsulated wiring or poorly grounded fixtures are an electrical shock hazard if these materials come into contact with reflective insulation commonly installed under floors over unheated crawl spaces and basements. (3) Kraft vapor barriers installed with fiber batts and blankets pose a danger when overheated because they can heat the adjacent fiberglass material which may release toxic phenol vapors.

The risk of fire involving insulating materials can be mitigated by materials' standards and proper installation by qualified contractors. As mentioned above, selection of HVAC equipment and smoke detection equipment appropriately suited to the building's infiltration patterns will also alleviate any unnecessary risks.

Smoke and fire movement differs between commercial and residential structures. Since ventilating systems are not usually installed in residential structures, reduced ventilation rates may intensify concentrations of smoke and toxic substances during a fire.

Commercial buildings, however, do have ventilation systems, but they may shut off in the event of a fire. Fire spread,then, becomes dependent upon pressure differentials existing inside and outside the building. As pressure differentials increase (with the increased difference in temperature between lower and upper floors of the building or between indoor and outdoor temperatures) the stack effect (the upward movement of air) becomes more pronounced.

Fire and smoke damage can be partially mitigated by utilizing the building's ventilation system either to exhaust smoke and gases outdoors or by differentially pressurizing the building. The strongest criticism against the use of ventilation equipment for fire and smoke control is that this purpose is incompatible with reduced ventilation rates and energy conservation.

Additional research is necessary to: (1) determine the relative dangers posed by fire spread itself or smoke formation, (2) determine exactly how smoke movement is affected by temperature and pressure, wind speeds, and smoke density, and (3) coordinate ventilation rates and ventilation systems to maximize energy conservation and minimize danger from fire and smoke.

C. Conclusion

This brief review of specific pollutants is intended to serve as an introductory discussion for concerned consumers and members of the construction community. CECA believes that the potential dangers to public health presented by low infiltration rates are sufficient to demand the inclusion of air exchangers or other mechanical devices to control air exchange in any such approaches to energy conservation.

Appendix VII

Report of the Regulatory Analysis Review Group of the Council on Wage and Price Stability

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EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON WAGE AND PRICE STABILITY
WINDER BUILDING, 600 - 17TH STREET, NW.
WASHINGTON, D.C. 20506

April 30, 1980

Honorable Charles Duncan
Secretary
Department of Energy
Washington, D.C. 20545

Dear Mr. Duncan:

In my letter to you of January 7, 1980, I identified the concerns on which the Regulatory Analysis Review Group (RARG) was focusing in its review of the Department of Energy's proposed energy performance standards for new buildings. The RARG now has completed that review, and the outcome is the enclosed report, which I request be placed in the public record for this proceeding.

Sincerely,

R. Robert Russell
Director

Enclosure

cc: Members of Regulatory Analysis Review Group

Joan Bakos
Office of Conservation and
Solar Energy
Department of Energy
Docket Number CAS-RM-79-112
Mail Station 6B-025
(Room 6A034)
1000 Independence Avenue
Washington, D.C. 20585

DEPARTMENT OF ENERGY'S PROPOSED ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS (BEPS)

REPORT OF THE REGULATORY ANALYSIS REVIEW GROUP SUBMITTED BY THE COUNCIL ON WAGE AND PRICE STABILITY [1]

APRIL 30, 1980

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[1] The Council on Wage and Price Stability is an organization created by the Council on Wage and Price Stability Act (P.L. 93-387), within the Executive Office of the President. The authority of the Council to intervene in governmental rulemaking and ratemaking proceedings, conferred by Section 3(a)(8) of the Act, has been delegated to the Director of the Council (see 40 FR 52882).

EXECUTIVE SUMMARY

The Regulatory Analysis Review Group has completed its study of the Department of Energy's proposed new Building Energy Performance Standards (BEPS). This Report contains our conclusions and our recommendations for changes in the basic enabling statute and in the way DOE develops the program. 1/

Congress began consideration of energy performance standards for new buildings in 1975, out of concern that -- several years after the oil embargo -- builders in many cases still were not using proven conservation techniques. In deciding to authorize BEPS, Congress turned to a program already underway in the National Bureau of Standards to develop general performance standards (as opposed to standards that prescribe particular designs and thus limit flexibility) for new buildings. The enabling statute requires DOE to complete and to apply these standards to federal buildings and federal housing programs. Congress also left open the possibility that after final standards are issued, states and localities could be required to incorporate them into their own building codes and apply them to all new buildings.

Over the past five years, the energy situation has changed considerably, and the justification for a nationwide BEPS program has been weakened. There are two major reasons for this:

- o It appears that better energy conservation techniques are being applied in new construction. For example, when BEPS was first considered in 1975, only 2 percent of new homes were equipped with heavy ceiling insulation (at an R-value of 30 or more). By 1977, almost 30 percent were heavily insulated.
- o Other programs to encourage conservation are taking effect:
    - -- With some success, DOE has been encouraging states and localities to adopt the component performance standards of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
    - -- Policies are being adopted to make energy prices reflect true cost; these policies include crude oil decontrol and peak pricing of electricity.

After careful consideration, we recommend that:

- o DOE and Congress reassess the desirability of BEPS and consider replacing it with other conservation programs, or, at the very least, postpone its effective date.

1/An Addendum attached to this Report contains remarks of the Department of Energy.

- If Congress does not modify the BEPS legislation, DOE should refocus the program to address those areas where the building industry otherwise would fail to conserve as much as it should.

Our misgivings about the program are serious:

(1) It is impossible to determine with assurance whether the stringency of the standards is too great, too little, or just about right. Although DOE, HUD, and the Congress have been concerned for over 5 years with the use of energy conservation techniques, we still have so little information on current industry practice and on the benefits from additional conservation that we simply cannot determine the extent to which the proposed standards will help.

(2) It is not even clear what kind of market failure BEPS is designed to remedy. The proper government response to inefficient building design depends in large part on the reasons the industry is not conserving adequately. There are several possibilities:

- Energy prices based on lower, rolled-in average cost, rather than on marginal cost, due to rate regulation.
- Social costs borne by the nation as a whole, such as the vulnerability to an embargo of oil imports.
- Myopic behavior, whereby builders and consumers take insufficient account of rising energy prices.

If the failure in the market is myopia caused by lack of information, mandatory performance standards are unlikely to help. In principle, such standards could address either mispricing of energy or myopia caused by financial or other institutional impediments. However, other approaches might be as useful in principle and less difficult to apply in practice.

(3) It may be impossible to determine the proper rates of trade- off among fuels in meeting standards. DOE's proposed "weighting factors" (determining the rate of trade-off) erroneously are based on differentials in cost already accounted for by the market, as well as on other social costs. Setting correct weights would require framing the extent of myopia in the market.

(4) Variation in energy use among buildings is too great. Even though DOE has been very thorough and its proposal is highly complex, the proposed standards are still not particularized enough to take account of all the factors that should affect the appropriate level of conservation. In some cases, BEPS will be too lax, partly because the proposal relies on techniques and studies that are several years old and partly because the standards as a practical matter cannot be adjusted for all the circumstances that warrant additional conservation efforts. In some cases, the program will be unrealistically strict, imposing excessive costs on builders and consumers.

(5) The implementation effort has a long way to go. Little visible progress has been made in developing building codes that are equivalent to BEPS, which Congress expected to be the major mode of implementation. Yet, unless Congress acts to postpone BEPS, all federal buildings (6% of commercial construction) and federally funded housing programs (15% of all housing starts) will be legally required to comply with BEPS each year beginning in 1982, without proper means for either the government or builders to be sure that compliance is achieved. In addition, mechanisms for implementation are needed that allow easy updating of the standards as energy prices rise.

Our Report lists other problems as well.

There are a number of alternative programs to BEPS that may foster conservation in new construction more effectively and efficiently:

- Programs to train or advise designers in the use of current and advanced conservation techniques.
- Assistance to states and localities to modify building codes.
- A labelling program under which every prospective buyer of a new building would be told its design energy use.
- A pilot BEPS program only for federal buildings, or in volunteering states.
- A program of minimum prescriptive standards, or more broadly applicable ASHRAE standards.

Even if Congress declines to amend the statute, DOE can improve the program without new legislation by:

- Gathering and analyzing more information on energy efficient building design.
- Researching the reasons for current inefficient designs.

- Applying weights to different fuels to reflect appropriately the social cost of energy use.
- Developing reference building designs to determine compliance.
- Considering whether a noncompliance fee sanction could be used to increase program flexibility.
- Considering reducing the stringency of BEPS and clearly characterizing them as "minimum acceptable" standards.
- Revising the Standard Evaluation Technique to make it a more accurate indication of actual energy consumption.
- Revising the influence of different energy budget categories to be more consistent with actual effect on building's energy use; further, explicitly stating why each budget category has been chosen.
- Examining how to maintain indoor air quality economically
- Accelerating development of a complete implementation plan.
- Developing better estimates of the costs and benefits of BEPS.

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Addendum: Remarks of Department of Energy

I. INTRODUCTION

The Energy Conservation Standards for New Buildings Act of 1976 (the Act) 1/ requires that the Department of Energy (DOE) promulgate building energy performance standards (BEPS) for new commercial and residential buildings by August 14, 1980, with the standards to become effective within one year thereafter. DOE issued an advance notice of proposed rulemaking (ANOPR) on November 21, 1978, 2/ and published the NOPR on November 28, 1979. 3/ On December 7, 1979, the Council on Wage and Price Stability (CWPS) notified DOE that the Regulatory Analysis Review Group (RARG) had selected the proposed standards for review. Subsequently, on January 7, 1980, RARG sent to DOE through CWPS a tentative list of the concerns to be addressed by RARG.

The proposed rule includes a set of Design Energy Budgets, expressed in thousands of British thermal units (MBtus) per square foot of floorspace. The format is a set of tables listing 1404 such budgets: for 18 building types (detached single-family homes, attached single-family homes, and 16 various classes of commerical structures) in each of 78 different geographic locations. 4/ The basic requirement of the proposed rule is that a new building's Design Energy Consumption not exceed its assigned Design Energy Budget, or that the building conform to an equivalent approved state or local building code. Design Energy Consumption is a

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1/ 42 USC 6831 - 6840.

2/ 43 FR 54512.

3/ 44 FR 68120.

4/ In addition, for single family homes, the budget numbers vary depending upon whether the house is heated by oil, gas, or electricity. Standards have not been issued for mobile homes, restaurants or industrial buildings.

building's projected annual consumption of various types of energy, converted into MBtus/sq. ft., as calculated under a Standard Evaluation Technique provided by DOE, or under an approved alternative evaluation technique. Among other key features, the Standard Evaluation Technique assumes certain standard building operating conditions and does not count use of renewable fuels (e.g., solar energy). The standards will apply to nonfederally financed buildings only if both Houses of Congress so resolve within 90 legislative days after the final standards are promulgated. Even without this sanction, however, the standards will apply to federal governmental and certain other directly federally financed buildings, which may effectively induce industry-wide compliance efforts.

A. Scope of RARG Report

The foregoing simple statement of the proposed rule highlights some of the key issues addressed in RARG's Report: the rationale for the specification of building energy budgets, how the budget levels are set, how Design Energy Consumption is determined, how different fuels are treated, the difficulty of tailoring Design Energy Budgets, and difficulties in implementing BEPS.

Many of the design elements utilized by DOE in developing these proposed standards appear to have been dictated by the Act itself. For example, the Act appears to require that BEPS be applied to buildings at the design and construction stage. It envisions enforcing the standards primarily through state and local building codes. Furthermore, it does not authorize the use of such potentially efficient approaches as taxing energy use, or encouraging energy-efficient designs through such means as tax subsidies. 1/

RARG's normal policy is to avoid questioning constraints placed upon an agency by statute. Instead we concentrate on how the agency can develop the "best" set of regulations within these constraints. In this case, however, our examination suggests that the basic approach of the statute itself -- requiring mandatory, whole-building, design-stage, energy performance standards -- has such inherent difficulties that there may be no set of standards the agency can develop that will lead to overall cost-effective improvement in building design energy efficiency. Moreover, several years have passed since BEPS was enacted, during which the building market has had an opportunity to respond to higher energy prices, and there have been changes in national energy policy, most notably the decision to move toward replacement-cost pricing of energy resources. For these reasons, certain of the problems the Act originally was intended to correct may be less significant today, and RARG's analysis indicates that the BEPS approach is probably not a feasible solution to the particular energy-related market failures that may indeed exist today. Therefore, RARG concludes that it would be desirable for Congress to release DOE

1/ The Internal Revenue Code contains provisions that in effect subsidize energy conservation and use of renewable energy resources, e.g., 26 USC 44C, "Residential Energy Credit." See also DOE's proposed "Energy Audit" program, authorized by Title II of the National Energy Conservation Policy Act, which is largely informational.

from the requirement that final BEPS be issued in August 1980, so that DOE may undertake a comprehensive reassessment of the program.

We are less hesitant to broaden our examination of BEPS than we otherwise might be because Congress itself reserved decision on whether to apply federal sanctions for noncompliance until the final standards are promulgated. Unlike most regulatory programs, BEPS will not go into full effect unless Congress takes affirmative action and is convinced it is an appropriate and effective response to circumstances that exist at the present time. RARG's report will address this issue, by distinguishing to the extent possible between problems with the proposed standards that DOE can remedy (at least to a significant degree) and intractable problems in the BEPS approach itself.

B. Statutory Background

In authorizing the BEPS program in 1976, Congress' chief stated purposes were to assure that new buildings would incorporate "reasonable energy conservation features" and to establish performance standards "designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of non-depletable sources of energy." 1/ The Act requires promulgation of "performance standards," which are defined to be "energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed...." 2/ The National Bureau of Standards in the Department of Commerce had already begun research on such a building energy performance program.

The Act originally placed responsibility for both developing and implementing the standards with the Department of Housing and Urban

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1/ 42 USC 6831 (b).

2/ 42 USC 6832.

Development (HUD). Congress transferred the authority to develop and issue the standards to DOE when that Department was created, 1/ but it left authority to implement and enforce the standards with HUD. In devising the standards, DOE is to consult with the National Bureau of Standards, the General Services Administration, the National Institute of Building Sciences, and representatives of the building community. 2/ The standards must make "allowance for" climatic variations among regions of the country, and there must be provision for updating. 3/ In developing the standards, DOE is required to analyze their economic cost and benefit, as well as their effects on institutional resources, energy efficiency, use of nondepletable resources, habitability, and affected groups. 4/

The final standards, which are to become effective no more than one year after promulgation, will apply automatically to federal governmental buildings and to buildings that are directly federally insured or financed. 5/ The standards will not be applicable to other buildings unless both Houses of Congress pass a resolution to this effect within 90 legislative days after DOE promulgates final standards. 6/

1/ Department of Energy Organization Act of 1977, 304(a), 42 USC 7154(a).

2/ 42 USC 6833(a), 6838.

3/ 42 USC 6833.

4/ 42 USC 6839.

5/ 42 USC 6835, Section 252, National Energy Conservation Policy Act of 1978.

6/ 42 USC 6834(c). There would appear to be no obstacle to Congesss simply enacting legislation at a later date that federally enforces the standards.

The Act does not expressly require that BEPS be applied at the design and construction stage. It does, however, urge that the standards be enforced through state and local building codes or other construction control mechanisms; require that the standards be met by federal buildings at the construction stage; require that the standards be enforced (with congressional approval) by withholding financial assistance at the construction stage; and require that the standards apply only to new buildings. 1/ DOE has concluded that the Act thus contemplates standards applying to the design and construction rather than to the actual use of new buildings. 2/

C. Summary of RARG Report

RARG's recommendations to DOE for further action on BEPS are outlined in the final section of Part I.

Part II ("Net Economic Benefits of BEPS") examines the potential economic benefits of the proposed standards. It first

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1/ 42 USC 6831(a), (b); 6834; 6835.

2/ Under the right circumstances, design-stage energy performance standards may be a feasible and appropriate way to induce efficient energy conservation. The major federal regulatory effort in this regard prior to BEPS has been the corporate average fuel economy (CAFE) standards for automobiles, which began with the 1979 model year. The CAFE program has generally been considered to be working as anticipated, and it might initially be thought that an analogous program could be feasible in the case of new buildings. However, examination of the reasons the CAFE program has been feasible reveals that a similar program for buildings is likely to be infeasible. RARG undertakes such a comparative analysis of the two programs in Appendix I, illustrating that the problems faced in attempting to develop and implement BEPS are inherent in the basic approach of mandating performance standards for buildings.

examines how DOE selected the proposed Design Energy Budget levels, pointing out the major sources of unreliability in the budget selection procedures. Part II then focuses on DOE's draft Regulatory Analysis and the Economic Analysis on which this draft was based. While recognizing DOE's substantial effort to comply with the Regulatory Analysis requirement of Executive Order 12044, RARG is not convinced that the Regulatory Analysis reliably estimates the cost of BEPS or correctly specifies the baseline case; that is, the amount of design energy consumption without BEPS. The third section of Part II examines possible market failures in this baseline case that might justify government intervention with respect to building energy use; RARG concludes that the BEPS approach may be inappropriate given the nature of market imperfections that might reasonably be expected to exist and urges DOE to undertake more research on this matter.

Part III ("Weighting Factors") examines a particularly important and complicated aspect of determining a building's Design Energy Budget and Design Energy Consumption: the choice of weighting factors for various energy sources included in the budget. The Act does not specify what weighting factors should be used. RARG concludes that DOE's approach to weighting factors, whereby weights are based on full social cost, is incorrect. Instead, the only portion of social cost that should be given weight to be counted against the BEPS regulatory constraint is the portion not accounted for in the private market. Depending on the nature of the market failure, it may be impossible for DOE to obtain the necessary data even to approximate the correct weighting factors. If this turns out to be the case, then the entire BEPS approach -- i.e., the Act itself -- should be reconsidered because of the impossibility of determining what BEPS are efficient.

Part IV ("Variance in Building Energy Use") addresses a central conceptual issue raised by the BEPS approach: how to reduce building design energy use in an efficient manner, given the large number of variables affecting energy use and the large variation in building design. RARG presents for DOE's consideration an alternative BEPS format, within the terms of the Act but not using explicit energy "budgets," that could clarify the function of the standards and reduce the extent to which they induce inefficient designs. In addition, Part IV suggests that DOE could increase the flexibility and the cost-effectiveness of the standards by allowing payment of a graduated noncompliance fee for buildings that do not meet the standards, and could avoid some of the inefficiencies traceable to the variance problem by issuing less stringent BEPS.

Part V discusses the difficulty of implementing building energy performance standards, particularly given the implicit statutory requirement of developing equivalency state and local building codes.

Part VI concludes with a plea for caution in the face of the significant difficulties explored in this Report. One option, apparently within the terms of the statute, would be for DOE not to seek standards that minimize life-cycle costs in every individual case, but to set "minimum acceptable" standards. Given the uncertainties and inflexibility associated with mandatory energy performance standards for buildings, it may be wisest to set standards to eliminate the clearest instances of wasted energy. This would reduce the likelihood of introducing inefficiencies due to the standards being too stringent for some buildings.

D. Recommendations to DOE

1. Timetable for Further Action

- o RARG concludes that it would be preferable not to issue final BEPS by August 14, 1980, as DOE is now statutorily required to do. Therefore, DOE should consult with Congress as to the feasibility of postponing the date of promulgation of final BEPS (or, less preferably, postponing the date of effectiveness of the final standards).
- o If such postponement is not feasible, DOE should
  - -- recommend to Congress that it not take action (during the 90-day layover period after final promulgation) to apply the statutory sanction making the standards mandatory nation-wide as a matter of federal law.
  - -- make the effective date of the standards a full year ? after final promulgation, and
  - -- make a commitment to Congress to develop prior to the effective date a set of legislative recommendations, on the basis of a comprehensive assessment of the present desirability of a BEPS program.

2. Reassessment of BEPS

- o DOE should undertake a comprehensive reassessment of the present need for and desirability of a BEPS program.
- o As part of this reassessment effort, DOE should compare the proposed mandatory design energy performance standards, along with the BEPS implementation plan, to alternative or less ambitious building energy conservation programs such as
  - -- informational and educational programs for the public and for design professionals;
  - -- programs of technical and other assistance to states and localities;
  - -- voluntary or mandatory building energy performance labelling programs, using uniform evaluation methods to determine design energy consumption;

-- pilot BEPS programs for federal buildings or in volunteering states or localities; and

-- a program of minimal prescriptive or component performance standards.

3. Further Data Collection and Analysis

Within the time schedule recommended above, DOE should

- undertake more research on the life-cycle cost of various building-design energy conservation measures;
- examine the nature and extent of energy-related market failures in the building industry;
- revise its approach to weighting factors to account more appropriately for the external social costs associated with building energy use;
- investigate the practicability of altering the format of BEPS from MBtu "budgets" to reference designs;
- explore the possibility of allowing greater flexibility by applying a noncompliance fee as an alternative sanction;
- examine the relative costs and benefits to be gained by decreasing the stringency of the proposed mandatory BEPS and characterizing them as "minimum acceptable" standards.
- revise the Standard Evaluation Technique so that it is a reasonably accurate estimation of actual energy use;
- revise the influence of different Design Energy Budget categories (DEB parameters) so that they are consistent with actual effect on building use;
- explain on what basis each parameter was chosen, including the separate categorization by fuel type for single-family homes;
- examine the costs in terms of indoor air quality of various conservation efforts, and determine the appropriate manner for BEPS to deal with this issue;
- develop and receive public comment on a complete implementation plan that will allow designers to utilize either a performance path or an equivalency (e.g., building code) path;
- revise the baseline case in the Economic Analysis and obtain better estimates of the costs and benefits of BEPS.

II. NET ECONOMIC BENEFITS OF THE PROPOSED STANDARDS

The draft Regulatory Analysis issued with the NOPR asserts that the BEPS program will result in substantial energy savings over the next 20 years, and that the proposed standards are set at levels that will maximize net benefits to individual building owners and to the nation. However, these claims depend both on the precision and reliability of DOE's procedures for selecting the standards and on the proposition that in the absence of BEPS new buildings will be designed to consume an inefficiently large amount of energy. This Part first examines the data base and procedures used to select the proposed standards. These are too unreliable to support the conclusion that either the single-family or the commercial standards can be expected to maximize net benefits for the individual building owner or the nation.

Perhaps because it viewed as preemptive the finding in the Act authorizing the BEPS that building design is "wasteful," 1/ DOE did not, prior to issuing the NOPR, examine in detail the reasons the market will produce inefficient buildings, and has not presented a specific rationale for government intervention. This part of RARG's Report examines these issues. If the congressional premise of large-scale inefficiency in building design is not true under current and prospective conditions in the building market, then the desirability of BEPS is open to question. Hence, it is important for RARG to address and for DOE to research and report on the issue of design energy efficiency in the absence of BEPS.

1/ As pointed out at greater length in the next section of the Report, the Act contains a finding that large amounts of energy are wasted in buildings and that performance standards can prevent such waste.

Therefore, the second section turns to the draft Regulatory Analysis, concluding that its assertions as to the amount of energy savings and of net benefits due to BEPS are highly uncertain at best.

The third section considers several possible sources of market failure in the building industry, and concludes that there is no a priori basis on which to gauge their magnitude. Moreover, while mandatory performance standards could in principle help correct certain of these market failures, other forms of government intervention may be more suitable and practical.

A. Setting Design Energy Budget Levels

DOE, which took over development of BEPS from HUD in 1977, was forced to develop the proposed standards within some formidable constraints. For example, it faced a tight statutory deadline, significant statutory limitations on the type of program permitted, inadequate information about design-stage conservation measures, the absence of previous work on implementation procedures, unsettled energy and building markets, and the necessity of relying on unproven computer simulations and on energy use data previously collected by HUD.

1. Single-Family Standards

In preparing to develop the standards for single-family residential structures, HUD had undertaken an extensive research program, described in Chapter 2 of the NOPR. The research program began with compiling a data base of 120,000 dwellings constructed in 1975-76. This data base was used to develop energy efficient redesigns.

After the redesign program was completed, responsibility for developing BEPS was transferred to DOE.

DOE adopted a fundamentally different approach for single-family residences. DOE sought energy budget levels that would minimize the present value of the average expected life-cycle cost of owning, operating, and maintaining a home built in 1980. A computer program was developed to simulate four prototypical houses for 10 cities with varying climates. The resulting simulations allowed DOE to estimate the least cost combination of available energy conservation features, and to identify the corresponding design energy budget, for each house type in each location. DOE found that the three prototype detached houses produced similar results. Accordingly, DOE has developed energy budget levels for only two single-family residential categories: attached and detached homes. 1/ By regressing design energy requirements against heating and cooling degree-days, DOE came up with estimates of minimum life-cycle cost BEPS for a total of 78 SMSAs.

There are three major reasons that it is doubtful the single-family standards will in fact properly minimize life-cycle cost for individual buildings. First, due to the small number of different building prototypes and the even smaller number of single-family categories in the proposed rule, the standards do not vary nearly to the extent of the variance in design energy use of single-family residences. As a result, the proposed BEPS at best minimize life-cycle costs for the prototypes, but may be too lax or too stringent

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1/ In each of these two categories, there are different budget levels for oil, gas, and electricity-heated homes. Part IV discusses difficulties with this decision.

for other homes. This is but one instance of the pervasive difficulty, inherent in the BEPS approach, of dealing with variance in building energy requirements among similar buildings. This issue is discussed in more detail in Part IV. However, a greater number of prototypes and budget categories would be a partial solution to this instance of the variance problem.

A second, somewhat related, difficulty is that the operating conditions of homes will differ from the standard operating conditions assumed in simulating energy use in order to select minimum life-cycle cost design standards. As a result, some energy design modifications may be in effect "wasted" because they are not taken advantage of in operation. This problem is also inherent in an approach that requires design-stage standards; given that requirement, it appears DOE had no choice but to assume standard operating conditions for each building type.

A third reason the single-family home standards do not properly minimize life-cycle costs is that DOE used market energy prices, without incorporating any "social premium" value of energy use from different sources. 1/ If DOE intends BEPS to correct the failure of market prices to reflect full social costs, then using market prices inappropriately relaxes the stringency of the standards.

In addition to social costs associated with energy use, there may be social costs associated with reducing energy consumption through increased building design efficiency. Cutting down on heat loss or gain from outdoor air by tightening building construction so as to decrease air changeover rates may simultaneously increase indoor air pollutants, possibly to dangerous levels. DOE has sought

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1/ The concept of social premium is discussed more thoroughly in Parts II and III.

to assure that this problem is not worsened by BEPS, by providing that energy saved through designing changeover rates below the present average for new buildings (0.6 per hour) is not recognized under the Standard Evaluation Technique (SET). This is a proper solution only if the existing average is not too lax, an issue which DOE and the Environmental Protection Agency (EPA) are now jointly researching. Even without BEPS, indoor air pollution may increase simply due to design modifications in response to higher energy prices. In the interim, DOE should continue to look for cost-effective ways to assure adequate indoor air quality. 1/

2. Commercial Standards

For the commercial standards, DOE relied on the data collected under HUD's two-phase sampling technique. Phase I was a random stratified sample survey of 3,221 new commercial buildings designed after 1973 and built in 1975-76. The 1,661 usable responses to the survey were used to estimate the baseline case distribution of design energy consumption. Phase II involved a subsample of 168 buildings. These buildings were redesigned to be more energy-efficient by architects who had been given a short training course in proven energy conservation techniques. After the redesigns were completed, the energy savings and the change in net present value of the new designs

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1/ For instance, the SET could be developed to give credit for measures to reduce air infiltration if they were coupled with appropriate pollution control techniques. Air-to-air heat exchangers may be a particularly promising approach for not only preventing deterioration of indoor air quality in energy-efficient buildings, but perhaps even improving it. Heat exchangers can both ensure adequate air-change rates and save substantial amounts of energy by preheating and precooling incoming outdoor air to a temperature closer to indoor conditions.

over the originals were calculated. DOE then chose the standard for each building type in each climate zone by setting the budget at a level at least as great as that used by a certain percentage of redesigns. For most building types, the budget was set at the 50th percentile level -- meaning that half of the redesigns could meet the standard without any further conservation measures, and half could not. 1/

The problem associated with energy use variance, standard operating conditions, and use of market prices discussed with respect to single-family homes also apply with respect to the commercial standards. Moreover, there are several additional reasons that the foregoing selection procedures give no assurance that the commercial building standards are socially cost-effective. First, only 50 percent of DOE's Phase I inquiries drew responses, and the nonresponses and unusable responses were apparently not analyzed to determine whether the remaining sample was representative. Second, the Phase II subsample (168 redesigns) is actually quite small, because it contained only one or two buildings of each type in each of the sample selection strata. A subsample of that size is too small to give a statistically reliable representation.

1/ In addition to relying on the design-redesign data, DOE also performed one life-cycle cost analysis, for large office buildings. That analysis indicated that the 50th percentile level did not require enough energy investment -- i.e., that it was too lax. However, professional subjective judgments relied on by DOE indicated that the design community is unfamilar with the practices that would be necessary to meet commercial standards more stringent than those in the proposed rule. See NOPR, p. 3.4.

Third, the Phase II redesigns were never subject to two crucial tests: the redesigned structures were never actually built; and the original clients were never asked whether they were satisfied with the redesigns. The architects doing the redesigns were instructed to meet the clients' specifications for the original buildings, and to "keep construction costs in the same general range. . ." 1/ Given that the redesigns were never evaluated by the original clients, these instructions may have encouraged the architects to save energy by trading-off amenities and other attributes of the buildings (in addition to construction costs). Hence, the observed small increase in cost (less than 4%) may have obscured a much larger decline in the buildings' value to clients.

The final, and perhaps most significant, source of difficulty is the peculiar manner in which the commercial budget levels were set. DOE set the standard for each building type in each climate zone by first estimating the energy consumption of the redesigns in each decile of the distribution, and then choosing an energy-use level corresponding to a certain percentile. There is no pretense that these energy-use levels -- at the 50th percentile in most cases, the 30th percentile for office buildings, and the 70th percentile for multifamily units and hospitals 2/ -- were chosen to maximize the net present value of energy-saving investments. DOE estimates that for most building types the average net present values of energy

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1/ NOPR, p. 2-11.

2/ A 30th percentile level means that 30 percent of the redesigns could and 70 percent could not meet the standard. The reader may wonder how a sample of one or two buildings could have percentile levels. The answer is that DOE assumed that the distribution of energy use in Phase II replicated the pattern in Phase I.

conservation measures in the redesigns are positive but that for a significant percentage of buildings of each type the redesign measures have a negative net present value. 1/

Given the weak data base, substantial reliance on mathematical simulations of energy use, and an unexplained decision to set budget levels at the 50th percentile level, RARG is unable to ascertain even whether the commercial standards are, in general, more or less stringent than what would occur in the absence of BEPS. The importance of examining this baseline case, and the problems with DOE's efforts in this regard to date, are discussed further in the following section.

B. DOE's Draft Regulatory Analysis

Executive Order 12044 requires that major regulations be accompanied by a Regulatory Analysis that examines the economic and other effects of the proposed regulation and of alternatives to it. A Regulatory Analysis is not intended to be an ex post cost-benefit justification of a regulatory program, but a

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1/ Economic Analysis, p. 4.52, Table 4.22. The Economic Analysis does not clearly indicate whether these net present value calculations were for buildings redesigned to meet the standard or merely for all buildings redesigned. In addition, in calculating the present values, DOE made the debatable assumption that operating and maintenance costs of redesigned buildings would be the same as for the original designs.

decisionmaking tool used in developing the program. 1/ Similarly, the Act requires that DOE consider the costs and benefits of alternative standards, as well as their effect on energy efficiency, the use of nondepletable sources of energy, habitability, and effected groups. 2/

DOE has made a substantial effort to comply with these requirements. The draft Regulatory Analysis and Technical Support Documents are extensive, and DOE's decisions are generally grounded in the data and analysis presented therein. As soon as DOE was made responsible for developing the BEPS program, it undertook an Economic Analysis (Technical Support Document No. 8) of the effects of standards of varying stringency, which became the major basis for the draft Regulatory Analysis. In the case of single-family homes, the economic analysis took the form of a search for those building designs

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1/ 43 FR 12661 (March 24, 1978. Another requirement of E.O. 12044 is that there be an opportunity for early and meaningful participation and comment by the public. DOE has provided a five-month comment period on the BEPS NOPR, and has received public comment on the earlier ANOPR. RARG is concerned that nonetheless the public may not have had an adequate opportunity to comment on BEPS. The NOPR does not include a developed implementation proposal, and DOE has yet to publish or make available equivalent building codes. The performance standards alone are sufficiently abstract that those who must comply with and administer them cannot be expected to comprehend their impact without a full implementation plan. Given the diverse nature of the building industry and its traditional reliance on prescriptive building codes, and the diversity of local building codes and local enforcement practices, it is possible that the industry and local governments have been unable to consider in meaningful detail the actual effects of the proposed standards, as they would be administered, and less able than they otherwise would be to offer practical suggestions for improvement.

2/ 42 USC 6839.

with minimum life-cycle cost, from which energy-use budgets were derived. However, in setting the standards for multifamily and commercial buildings (on the basis of building design and redesign data previously gathered by HUD which are not sufficiently detailed to allow life-cycle cost analysis), DOE did not attempt to balance economic costs and benefits. Although the Economic Analysis attempts to project the costs and benefits of the proposed commercial standards for most building types, DOE apparently did not base its choice of standards on these projections.

The central conclusions of the draft Regulatory Analysis are that the proposed BEPS would result in cumulative energy consumption "savings" between 1985 and 2020 of 29 quadrillion Btu's (quads), would increase the first cost of single-family homes by approximately 2 percent (which would be recovered by homeowners in the form of energy savings in 2-8 years), would increase construction costs for commercial buildings by 3.6 percent, would be of net benefit to averag building owners, and would have net present value of $6.03 billion to the nation. 1/

The general methodology DOE used to estimate the economic effect of BEPS was sound. DOE first projected energy use, building costs, and certain aggregate economic indicators under the baseline case -- the case that would obtain in the future without a BEPS program. In choosing the baseline assumptions, DOE recognized that increases

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1/ Regulatory Analysis, pp. 2-4, 4-3. The NORP and the draft Regulatory Analysis also assert that 40% of energy use in buildings is currently "wasted" due to "inefficient design" and indicate that this amount would be saved under BEPS. See, e.g., NOPR, p. 6-2; draft Regulatory Analysis, p. 1-1. However, this assertion is nowhere documented and appears to have been reported solely on the basis of a similar assertion of energy "waste" in Yergin and Stobaugh, Energy Future, see draft Regulatory Analysis, p. 3-8.

in the real price of energy and other government conservation programs will lead new buildings to be more energy efficient even without BEPS. DOE then projected energy consumption, costs, and economic conditions assuming the BEPS program is fully implemented. DOE attributed the difference between these forecasts and the baseline forecasts to BEPS.

Unfortunately, the uncertainties in the underlying data are so substantial that a wide range of conclusions is possible, and the Economic Analysis' estimates of energy savings due to BEPS can be given little weight. BEPS can benefit building owners only to the extent designers do not minimize life-cycle costs in the absence of BEPS. DOE cited two sources of evidence that designers would not otherwise employ conservation measures to minimize life-cycle costs: the Oak Ridge energy model used to project baseline consumption, and the data on 1975-76 design practice gathered by the National Association of Home Builders (NAHB). The Oak Ridge model incorporates 272 price and income elasticities, which represent the responsiveness of demand for energy to changes in income and price. 1/ But, as its authors admit

> "Unfortunately, the statistical basis for many of our cross-price and income elasticities is weak. Lack of detailed data forced us to make several assumptions to derive the 272 elasticities used in the simulation model. Also, the applicability of fuel price and income elasticities derived with data from a period in which fuel prices were declining to a future in which prices are likely to rise significantly is unknown. Clearly, more work must be done to develop good data series on household fuel uses and prices and on econometric estimation to produce improved elasticity estimates. 2/

> "The weakest part of our present model related to the equipment market share and usage elasticities. These elasticities are obtained with an inadequate (and to some extent, inaccurate)

1/ E. Hirst and J. Corney, "The ORNL Engineering-Economic Model of Residential Energy Use," (ORNL/CON-24), Oak Ridge National Laboratory, July 1978.

2/ ORNL/CON-24, p. 37

> data base, poorly specified models, and are based on a time period that may not relate well to future changes. 1/

Given the inadequate information supporting the model, particularly as regards elasticity values, the results of the model are not an adequate basis for concluding that builders will not minimize life-cycle costs.

RARG is similarly skeptical of the present relevance of the data from the NAHB relied on by DOE as evidence of inefficient design practices in the absence of BEPS. These data were obtained in 1975-76 -- the beginning of a period of sustained price increases, when little was known about the cost-effectiveness of various building conservation techniques or about the likely course of future energy prices. Quick, dramatic adjustments in building practices would therefore not be expected. More recent NAHB data 2/ on residential ceiling and roof insulation in new homes show that average insulation R-values 3/ increased in

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1/ ORNL/CON-24, p. 71.

2/ NAHB Research Foundation, 1979 Research Results:

Insulation R-Value	1975	1976	1977
	(percentage of houses built during the year)		
R-14 or less	34	17	13
R-19 to R-26	64	80	59*
R-30 or greater	2	3	28

3/ R-Value is a measure of insulation effectiveness. The higher the R-Value, the greater the effectiveness.

1977 by approximately 20% over averaged 1975-76 practice.

Another factor suggesting that the Economic Analysis may underestimate the amount of energy conservation effort in the absence of BEPS is the assumption that under the baseline case, only 40% of new residential construction would be covered by state or local energy codes during the period from 1980 through 2020. This assumption appears too low in light of a 1979 study by the National Institute of Building Sciences, which shows that 36 states have authority to establish standards for new residential, non-residential, and public buildings. 1/

The estimates in the Economic Analysis of the costs of BEPS were derived from the same data and models used to set the standards, and are therefore subject to uncertainty for the reasons set forth in the previous section.

In conclusion, the extent to which the BEPS program will cause additional energy conservation design measures beyond that which would otherwise occur -- and thus the benefits and costs of the program -- remain highly uncertain. The Economic Analysis and draft Regulatory Analysis both need further work. In preparing a final Regulatory Analysis, DOE should, at a minimum, revise its baseline case projection to incorporate more fully the effect of increasing energy prices.

1/ NIBS, States' Energy Conservation Standards for New Housing and Buildings, 1979. RARG notes that the growing coverage of state energy codes -- and by extension, the growing use of conservation modifications in building design as indicated by the recent NAHB data -- may be due in part to efforts of the federal government beyond the BEPS research effort. The State Energy Conservation Plan program under the Energy Policy and Conservation Act of 1975, 42 USC 6321 et seq., provides strong encouragement for state building conservation codes.

C. Possible Market Failures to be Addressed by BEPS

The foregoing discussion indicates that DOE has not convincingly demonstrated to what extent in the absence of BEPS new buildings will be designed to use too much energy. The present section examines several potential sources of market failure that could result in excessive design energy use, and considers whether mandatory energy performance standards are an appropriate form of governmental intervention, under current conditions, to correct these failures.

The Act authorizing the BEPS program states that:

> "Large amounts of fuel and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings because such buildings lack adequate energy conservation features.
>
> "Federal performance standards for newly constructed buildings can prevent such waste of energy, which the Nation can no longer afford in view of its current and anticipated energy shortage." 1/

RARG believes it may be significant that Congress mandated BEPS at a time when domestic energy prices were, and might have been expected to remain, controlled. If a major reason that buildings in 1976 were perceived to be "wasteful" is that the price controls on energy encouraged such waste, then the BEPS program may be viewed as a device to achieve energy conservation in new buildings in the presence of controlled energy prices.

1/ 42 USC 6831(a)(1), (2).

Since the BEPS program was authorized, however, the nation has moved toward a policy of replacement-cost pricing for energy. Over the next few years, oil and gas prices will be decontrolled according to an announced schedule; many electric rates are being revised to encourage conservation. There also have been a series of legislative enactments to induce conservation investments beyond those dictated by the market, and to convert to less socially costly fuels.

In view of these significant programatic developments since 1976, we believe it important to examine closely the current and prospective need for BEPS. While the NOPR and background documents issued by DOE only occasionally and eliptically refer to sources of market failure that might be addressed by BEPS today, RARG believes that the effectiveness of the proposed regulations in dealing with the situation as it currently exists in the building industry is an important issue for consideration. In this section, RARG examines several imperfections that may exist in the market for new buildings: mispricing of fuels, imperfect information, and institutional rigidity. The latter two of these may produce behavior characterized by ignoring future energy costs to some extent (what is termed "myopic" behavior). We conclude that mandatory performance standards may not be the indicated remedy for any of these possible failures.

1. Mispricing of Fuels

If the prices that consumers pay do not reflect the full marginal social cost of energy, consumers may make socially inefficient decisions about how much and what types of energy to use. If gas, oil, and electricity market prices are less than their cost to society, commercial and residential buyers will underinvest in conservation technology and use too much energy. DOE cites two reasons that energy prices may be below marginal social costs: (a) rate regulation formulas cause energy prices to reflect average rather than marginal cost; and (b) energy prices do not reflect the social cost of domestic dependence upon foreign suppliers -- i.e., there may be a "social premium" on energy use. Environmental damage that can be associated with energy use also represents a social cost that market prices may fail to incorporate. 1/

When price does not reflect full social cost, government policies can attempt to correct this by applying a tax equal to the difference between the social and private costs. Alternatively, the government can mandate the choices that would be made if market prices were correct. Such a command approach requires much more detailed knowledge about the uses of energy than does a direct price-correcting policy. The BEPS program is a command approach, whereby the government seeks to project the outcomes -- the energy use per square foot -- that would occur if social and private cost were equated, and imposes these outcomes in the form of standards. It follows that if the only market failure being addressed is the mispricing of energy from certain sources, then the standards should apply only to those sources and only to the extent that their prices differ from marginal social cost. This fundamental policy prescription is explored in the discussion of energy source "weighting factors" in Part III.

1/ See also the discussion in Part IIA concerning a possible social premium cost in reducing design energy use, due to increasing indoor air pollution.

2. Imperfect Information

The prospective buyer or renter of a new building seeking to minimize total life-cycle costs could be impeded in his comparison of options because neither he nor the professionals designing the building have certain vital information concerning the costs and benefits of energy-saving design features. They may be unable to predict energy use or energy prices accurately, or may simply be unaware of the technological options available for improving a building' energy efficiency.

However, mandatory performance standards by themselves are not a solution to inadequate information. Merely mandating minimum life-cycle cost energy budgets may not be effective because the individual designer will still not have information needed to choose the appropriate mix of energy conserving techniques. As a result, the designer may meet his energy budget constraint through inefficient conservation expenditures.

The BEPS program, both as contemplated by statute and as developed by DOE, is not simply a set of mandatory performance standards. As explained further in Part V, BEPS will be implemented in conjunction with programs that will convey information. Model building codes and manuals of accepted practice will illustrate the conservation measures that may be used to meet the standards. The Standard Evaluation Technique, and alternative techniques approved by DOE, will be available to help building designers predict energy use accurately. Both governmental and privately sponsored training programs on efficient building design will be developed.

All of these steps to disseminate information could, however, be implemented without mandatory performance standards. For educating the public and the design community in efficient design techniques, mandatory building performance standards will undoubtedly serve as an effective attention-getting device. However, there are other ways, such as a building efficiency labelling program or the current State Energy Conservation Plan grant program, 1/ to draw attention to energy performance. If inadequate information is an important failure of the building market, an aggressive information/education program could generate most of the benefits while avoiding the efficiency losses and inequities associated with mandatory standards. RARG urges DOE to explore such alternatives and compare their costs and benefits with those of the proposed BEPS standards and tentative implementation plan.

3. Institutional Rigidities

DOE and others have pointed to institutional rigidities and barriers as reasons that the building market produces inefficient buildings. These include the tendency of builders to use standardized components (e.g., 2x4 studs in walls) and practices, the tendency of banks to ignore energy costs when evaluating mortgage eligibility, and the tendency of architects to minimize first costs rather than life-cycle costs. While obsolete practices may eventually disappear in response to higher energy prices, institutional inertia can substantially slow that response.

Institutional rigidities do not comprise a wholly discrete

1/ This program is pursuant to the Energy Policy and Conservation Act of 1975, 42 USC 6321 et seq. See also n. 17, Part II supra; and n. 19, Part V infra.

type of market failure. To some extent, these problems can be traced to inadequate information and can be remedied by providing better information. Institutional inertia may also be traced to real costs of changing past practices. For instance, abandoning the venerable 2x4 for the 2x6 will require substantial retooling of the lumber and building industries.

If there exist potential structural changes and solutions that reduce the cost of adjustment and that are not provided by the private market, government intervention may be justified. The costs in the building markets of adjustment to higher energy prices include basic research into building technology, retraining professionals and construction workers, and stepped-up retooling to produce different materials. The government can reduce some of the adjustment costs of responding to higher energy prices by funding appropriate research, or by disseminating existing or new information. Whatever form of intervention it chooses, it is important that the government recognize that most adjustment costs cannot be avoided simply through the expedient of mandating the energy use and construction designs that will prevail once the adjustment has been completed.

4. Myopic Behavior

Either lack of information or institutional rigidity and barriers may lead to behavior that can be termed "myopic": the ignoring, to some extent, of future energy costs. Such behavior leads to designing buildings as though the future path of energy prices is lower than in fact it is likely to be. As indicated above, myopia may characterize the behavior of builders, designers, lending institutions, building owners, or those who rent buildings, to the extent that these participants in the building market have imperfect information or face adjustment costs in attempting to respond to higher energy prices.

As is true of energy mispricing, myopic behavior can also in theory be remedied by mandatory performance standards. The next Part of the Report discusses how standards must be designed to address this problem, and suggests that in practice this likely would require more data than will ever be available to DOE.

5. Conclusion

DOE is now under statutory mandate to develop and issue mandatory building energy performance standards. Yet, on the basis of information provided by DOE to date, not enough is known about the causes of inefficient building design to make an informed judgment concerning the most effective form of government intervention. RARG urges DOE to undertake further research on this question.

RARG believes that unless there is both evidence of imperfections in the building market justifying performance standards in principle, and a clear demonstration of the availability of the information needed to develop and implement standards to correct such imperfections, mandatory peformance standards stand a good chance of causing inefficient building design. If the market, responding to other programs and incentives, results in the proper amount of energy conservation, then standards that constrain market behavior will, by definition, be too stringent and will force an inefficiently large amount of energy conservation investment in new buildings. Alternatively, if the standards are not constraining,then the standards are at best redundant, and there would be an unnecessary expenditure of funds by the government and the private sector to implement BEPS. (As noted in Part V, these expenditures are not trivial.)

Moreover, depending on the extent of imperfect information and adjustment costs in the building market, an insufficiently constraining BEPS program could have the perverse effect of reducing conservation investment to below that which would be undertaken in the absence of the program. This could occur if BEPS were characterized to the public and designers in such a way as to operate as a misleading "seal of approval" regarding design energy use. Because information is costly to obtain, designers, builders, and purchasers might substitute compliance with BEPS for a more rigorous analysis of life-cycle cost. Rather than develop or otherwise obtain information about energy-efficient designs, they might rely on BEPS, and go no further. Thus, depending on how BEPS is characterized, the efficiency losses due to BEPS that are too lax could be as great as the efficiency losses due to increases in building costs under BEPS that are too stringent.

It should be noted that both the foregoing problems are possible with standards that are labelled as minimizing life-cycle costs. As explained in Part IV, energy performance standards by climate and building type will inevitably be more stringent than is efficient for some buildings and more lax than is appropriate for others, due to the wide variation in building energy use, function, location, and design. This suggests that one important reason to research further the causes of building design inefficiency is to gauge the relative costs and benefits from each incremental increase in the stringency of BEPS.

III. WEIGHTING FACTORS

An issue that has received much attention from DOE and from industry groups commenting on the proposed rule is the selection of weighting factors for each fuel source used to heat or cool buildings. 1/ Weighting factors are the coefficients applied to the estimates of annual consumption of each fuel when adding these together to determine the building's Design Energy Consumption (DEC). The same weighting factors are implicitly incorporated in Design Energy Budgets (DEBS), because they are used to generate the tables of energy budget levels from which DEBs are derived. 2/

1/ DOE has indicated that a well-designed building will meet its energy budget regardless of what weights are used, see Weighting Factors TSD, P. 4. However, incorrect weighting factors may provide incentives to produce a poorly designed building which meets the budget, rather than a well-designed one. DOE has not performed a sensitivity analysis testing the effect of weighting factors on building design.

2/ Note that the issue of the proper relative values of the weighting factors is separate from the issue of the proper level of the BEPS constraint. Setting the weights proportional to something less than the full social cost of each fuel, as urged by RARG, is separate from the process of deciding the appropriate stringency of the standards, because the weighting factors themselves determine only the trade-off among fuel types in meeting a given performance standard.

In this Part, RARG explains that the proper choice of weighting factors depends on the nature and extent of failures that are believed to be occurring in the building market. RARG's analysis has two especially significant practical implications. First, although the Act authorizing BEPS does not mention weighting factors, 1/ there is no way to avoid selecting weighting factors, either explicitly or implicitly. This is because as long as more than one fuel is or might be used for building heating and cooling, weighting factors -- which define the trade-offs among fuels in determing DEBs and DECs -- come into play. Second, the appropriate set of weighting factors is very complex if certain types of market failures (those resulting in myopic behavior) exist. This complexity is so great that in RARG's view building energy performance standards would probably not be a feasible way of dealing with such market failures.

DOE's analysis in the NOPR of the weighting-factors issue is partially incorrect. DOE recognizes that its objectives in choosing weighting factors should not be to establish mere physical equivalency. However, DOE's decision to choose weighting factors equal to relative full social cost is correct only for

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1/Given that the Act does not directly address the choice of Weighting Factors, DOE has much discretion in this issue. RARG's proposed approach, which includes weighting for social premium value, would be consistent with the Act's stated objective of reducing reliance on nonrenewable fuels.

a very specific form of market behavior: the minimization of first costs without any regard to future energy expenditures. The choice of weighting factors must proceed from an analysis of the market imperfections affecting decisions in the building market and should be designed to encourage the socially efficient level of conservation of each fuel. Before explaining RARG's alternative approach, this Part presents an overview of the problem by discussing the various methods of setting weighting factors that DOE has considered.

A. The Proposed Weighting Factors

The BEPS constraint applies to the three types of delivered energy used in buildings: oil, natural gas, and electricity. These fuels have different characteristics, but they may be used as substitutes to a limited extent. Because BEPS are performance standards, the choice of fuel mix is not dictated by the relevant energy budget but is freely chosen by the building designer. The rate of trade-off among the three fuels within the budget is determined by the relative weights (coefficients) applied to the projected use of each fuel in calculating Design Energy Consumption.

1. Background: Alternative Approaches to Weights Considered by DOE

DOE has proposed weighting factors for different fuel types that reflect the relative full social costs of the fuels. This section explains how DOE arrived at this approach.

When presented with the problem of combining oil, gas, and electricity consumption into a single number representing energy use, an engineer's first instinct is to convert all forms of consumption to a common unit so that they may be added. Oil use is normally measured in gallons, gas in cubic feet, and and electricity in kilowatt-hours. The common unit traditionally used to represent all three is the British thermal unit (Btu). 1/

Expressing a building's energy use in MBtus (thousands of Btus) is sometimes called the "building boundary" or "site" approach, because it accounts for MBtus that enter the building boundary but disregards those that may have been used to produce and transport the delivered MBTus. In particular, the site approach disregards most of the energy used in an electric powerplant. For every MBtu of electricity delivered to a building, roughly 3 MBtus of fossil fuel must be burned in a conventional powerplant.

1/ A Btu is the energy required to raise one pound of water one degree Fahrenheit. One million BTUs is the energy equivalent contained in 7.5 gallons of heating oil, 970 cubic feet of natural gas, or 923 kilowatt-hours of electricity. Though the energy content of fuels may be expressed in common units, they are not thereby made commensurable. Btus of oil, gas and electricity are equivalent only in a limited thermodynamic sense; they are not equal in any economic sense.

The site approach entails weights that are all equal to one, but these weights are not thereby "neutral." 1/ They embody a particular set of trade-offs among fuel types, which will influence the relative demand for the fuels. In practice, BEPS weights based on a site approach would probably lead to a relatively higher consumption of electricity.

Because the site approach ignores Btus consumed outside the building boundary to furnish energy to the building, DOE chose a different approach in its a NOPR, using Resource Utilization Factors (RUFs). Under this approach, every Btu of electricity actually consumed to heat or cool a building would have been roughly tripled to reflect the fuel burned at the power plant that produced it. This alternative is sometimes called the "source" method of counting energy use. DOE also explored the use of Resource Impact Factors (RIFs), which would have adjusted the RUF weight for each fuel to reflect other social costs associated with its use.

The difficulties DOE encountered in determining appropriate RUFs and RIFs for each fuel led the agency to propose in the NOPR a different weighting scheme for reflecting full relative social cost. As noted in Part II, full social costs may differ

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1/ Some comments in response to DOE's ANOPR urged the agency to issue standards without weights, by which they meant the site approach. The site approach is not "weightless," however. If all the weights are set equal to unity, DOE can omit printing them in arithmetic expressions, but these weights will still affect the way builders react to the program.

from market prices for several reasons. First, in regulated markets, prices are often based on average costs rather than marginal costs. Second, the failure of the private market to account for pollution caused by use of a fuel or for national security considerations may mean that the marginal social cost of energy is greater than the marginal private cost. The weights in the proposed rule are roughly proportional to the average market price plus an estimate of the social premium for each fuel type. In the final BEPS rule, DOE proposes to modify its NOPR procedure by making the weights proportional to marginal social costs, rather than to average social costs.

Because prices generally reflect the resource cost of producing and delivering energy, a weighting approach based on costs is simpler and potentially more accurate than trying to determine RUFs and RIFs. It should be noted that one effect of this methodology is that the BEPS constraint effectively becomes a constraint on projected expenditures for energy use, rather than a constraint on some physical measure of energy use. While the NOPR and supporting documents continue to refer to the Design Energy Budget and the Design Energy Consumption as being expressed in "MBtus" or "weighted MBtus," it is more accurate and useful to think of these as having units proportional to dollars per year. 1/

1/ The proportionality factor is the price of gas, in $/Btu. This is because DOE normalized the weights so that the weight of gas is unity.

2. Why DOE's Approach is Not Appropriate

The only explanation DOE provides for its approach to weighting factors appears in the Weighting Factors Technical Support Document, in the form of an illustrative hypothetical. 1/ If a building is efficiently designed, then at the margin the discounted cost of additional conservation investment will be equal to the discounted energy savings from such investment. Now, suppose that fuel X has a marginal social cost of $15, and fuel Y has a marginal social cost of $5, per MBtu. Further, suppose that these are the prices in the market and that as initially designed, a building exceeds the relevant BEPS constraint (i.e., the assigned Design Energy Budget). The designer notes that at the margin, the annualized cost of a modification that saves an MBtu of X is $15, while a modification that saves an MBtu of Y will cost $5. Next, DOE implicitly assumes that in meeting the BEPS constraint this designer minimizes only the first costs of the building, rather than life-cycle costs. In these circumstances, the designer will clearly choose to save Y if Y and X have equal weights in the BEPS constraint, because another unit of investment to save Y is cheaper. However, if the weights are 3:1 for X and Y, the designer will be indifferent between saving a unit of X or Y. DOE concludes that the 3:1 weighting is "appropriate" because it results in fuel choices such that the marginal social costs of fuel savings are equal.

1/ Weighting Factors TSD, p. 12.

Unfortunately, this illustration contains assumptions that are contradictory. If the designer minimizes only first costs, then he initially will not come up with an efficient design. On the other hand, if he takes full account of relative future energy costs -- that is, he is not myopic -- in producing the initial design, then he probably also will not ignore these costs in meeting the BEPS constraint.

Thus, DOE's proposed weights (based on full social costs, including market price) are only correct if the building market totally ignores future energy costs, for only under this condition is a regulatory constraint needed to force the builder to face market prices. Unless there is such extreme myopia, the designer will take account of market prices in meeting the BEPS constraint; that is, he will attempt to satisfy the BEPS constraint in the way that costs the least. Conversely, as he attempts to minimize the total life-cycle cost of the building, he will take into account the trade-offs imposed by BEPS. The two constraints -- the normal budget constraint and the BEPS constraint -- must complement, rather than repeat, one another to produce the desired result.

Further, basing weights on full social costs logically implies that solar energy and firewood should have nonzero weights because these fuels also have nonzero social costs; yet because these fuels are renewable, the proposed rule does not count energy generated from them against a building's energy budget. Indeed, insulation and everything else the designer might spend money on have social costs. Nothing in DOE's approach distinguishes oil, gas, and electricity from other goods, or explains why they should be the only items with nonzero weights in the budget.

B. An Alternative Approach to Weighting Factors

To achieve DOE's objective of minimizing social costs, weights should be proportional not to marginal social cost, but, rather, to the difference between marginal social cost and perceived private cost. It should be noted that perceived private cost is not necessarily synonymous with market price; it may be less if building designers are myopic about future energy operating costs. This means that the relative weights should be based on the difference between market price and marginal social cost -- including the social premium -- for each fuel, plus any part of the future market price that building designers consistently disregard. The regulatory constraint can be used to correct the incentive facing designers, without overemphasizing that portion of total social cost already taken into account by the market. 1/

Exactly how weighting factors and market prices together influence the relative consumption of fuels is developed mathematically in Appendix I. The model used in this Appendix assumes that there are two types of market failure preventing the market from achieving the optimal level of conservation in building design: (1) mispricing of fuels, due in part to the existence of social premium values for oil, gas, and electricity; and (2) a tendency of designers to be myopic; that is, to ignore

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1/ If there is uncertainty about the practical effect of RARG's suggestion, it may be helpful to think of the Design Energy Budget as a second type of (i.e., nondollar) currency that a designer can spend on any fuel he chooses but which is required for purchasing energy projected to be consumed by the building. To provide the proper incentive for saving each type of fuel, two conditions must hold. First, relative prices (weights) in this artificial currency must complement real dollar prices in the market; that is, they must embody those costs -- and only those costs -- that the market fails to convey to the designer. Second, the effective exchange rate between the two currencies (dollars and the DEB currency) must be set in a way that preserves the complementary relationship of weights and prices. Because the exchange rate between the two currencies is the dollar value the designer would pay for an increase in the overall BEPS budget, it is determined not by the weights on the fuels, but by the overall stringency of the standards themselves and by the sanctions for noncompliance. These issues are discussed further in Part IV.

to some extent future fuel costs. Under these conditions, the model shows that the weighting factors should be set proportional to the mispricing differential (including social premium) for each fuel, plus that fraction of private cost that designers consistently disregard.

Hence, in order to derive the proper weights, DOE must continue its research into the marginal social cost and the social premium value of various fuels. Further, DOE must undertake research to determine the extent to which building designers ignore energy operating costs. Both market conditions need to be quantified before correct weights can be calculated. The issue of myopic behavior is particularly complex due to differences in this regard among participants (e.g., buyers, builders, etc.) in the market for buildings. In addition, RARG points out that using weights that reflect the average amount of myopic overdiscounting would simply elicit inefficient outcomes from all participants except those who overdiscount by this mean amount. The inefficiencies thus produced do not cancel one another. Therefore, if myopic behavior is an important problem and if individuals and others are myopic to varying degrees, there is no assurance that the BEPS program will result in efficient energy conservation, because it is impossible for DOE to develop and administer a program with universally appropriate weighting factors.

C. Conclusion: Defining "Performance" in BEPS

The question of what weighting factors to use is really a question of what measure of performance is appropriate in setting building energy performance standards. DOE has proposed energy performance budgets that measure total social costs associated with energy use; whereas RARG believes the BEPS budget should only correct market failures associated with energy use, by measuring (and hence making the designer consider) only that part of marginal social cost otherwise ignored. Mandatory performance standards for automobiles are able to use a simple summary statistic -- fuel economy -- as the measure of performance because consumer costs and external costs both vary directly with gasoline consumption which is the only type of energy source involved. However, when more than one fuel type is involved, mandatory performance standards must use an unorthodox measure, because external costs are not necessarily parallel to relative private costs of the various types of fuel. Because the performance sought to be constrained by mandatory energy performance standards is only that energy use which would not otherwise be constrained in the private market, each fuel must be counted only according to its not privately-accounted-for cost.

IV. VARIANCE IN ENERGY USE

The task of developing and implementing performance standards aimed at achieving maximum efficient energy conservation is complicated by the enormous variation in energy use among buildings, and by the large number of variables that influence energy requirements. The current version of DOE's Standard Evaluation Technique (SET) accepts some 2000 input variables and still provides only crude estimates of actual energy use. In this Part, RARG explains why variation in energy use makes it difficult to set the Design Energy Budgets accurately at the efficient level, and suggests two changes in the structure of the BEPS program to improve its flexibility. One change would alter the format of the standards from published numerical budgets to reference building designs. The other change would introduce flexibility in the performance path approach by providing that as a sanction for noncompliance, a builder could simply pay a commensurate noncompliance fee. RARG also notes that the tremendous variance in building energy use makes basing a regulatory program on DOE's maximum efficiency approach (minimum life-cycle cost) extremely difficult.

A. Design Energy Budget Parameters

The large variation in building energy requirements makes it necessary to develop a number of different Design Energy Budget (DEB) levels. A single standard of design energy use could not be used to dictate the efficient level of conservation for all buildings because it would be too strict for some buildings and too lax for others.

DOE's approach to the problem of variance in design energy consumption is to divide buildings into categories based on size (square footage), location (climate), and type (functional class), and to assign DEBs for each category. We shall refer to the variables that determine Design Energy Budget as the DEB parameters.

In theory, DOE could expand the list of DEB parameters, thereby greatly expanding the number of building categories and DEBs, and tailoring the DEBs more accurately to particular buildings. However, many variables that might theoretically be considered DEB parameters cannot practically be treated as such. These include particular conditions of use of a building (such as day or night use), aesthetic considerations (such as the availability of a view), and individual preferences of the building occupant regarding various design features (such as building envelope materials).

Increasing the number of building categories is not necessarily desirable. Once a building characteristic is designated a DEB parameter BEPS provides no incentive to designers to use that variable to improve energy efficiency. For instance, because single-family detached houses have a separate budget from that of attached houses, BEPS does not encourage designers to save energy by building attached rather than detached homes. DEB parameters are in a sense "protected" from BEPS because the DEBs are set to improve energy conservation under the assumption that these characteristics will not be changed. 1/

1/ This point is discussed briefly in DOE's Economic Analysis, p. 4-8.

Choosing a particular characteristic for treatment as a DEB parameter may turn on judgments about social policy implications. For example, if climate were not a parameter, BEPS might make it difficult to build buildings in the northern part of the United States. Likewise, building unattached single-family homes might be difficult if these buildings had the same budgets as attached homes. As these examples point out, in setting parameters there is often a direct trade-off between accurately adjusting the DEBs and saving energy. Therefore, DOE should be very specific about the reasons each DEB parameter was selected. An explanation is particularly needed for the separate DEBs assigned to single-family homes depending on the type of fuel used for space heating. Fuel type was not used as a parameter in commercial and multifamily DEBs; the rationale for using it in houses is not apparent. RARG urges DOE to review its selection of DEB parameters and to be explicit about the criteria used to choose them.

B. Achieving Parallel Treatment of Parameters

An effect of designating a variable as DEB parameter is to remove it from the influence of the standards. However, this does not occur completely if the relationship of the parameter to the Design Energy Budget (DEB) and Design Energy Consumption (DEC) is non-parallel. Such non-parallel treatment gives building designers unintended incentives to choose basic building characteristics that relax the BEPS constraint.

In some cases, the non-parallel treatment is obvious. For instance, the treatment of building size in the proposed rule is not parallel under the DEB and the DEC. The DEB increases linearly with square footage. The Standard Evaluation Technique applied to determine DEC, on the other hand, has a much more complex (and realistic) functional form, whereby doubling square footage less than doubles energy consumption -- i.e., results in lower energy consumption per square foot. The consequence of this non-parallel treatment of size is that builders are given an incentive to build larger buildings than they would build if size were given parallel treatment. While this might reduce overall energy consumption if it induces individuals who would ordinarily occupy separate buildings to double-up, this might have the opposite effect if individuals simply use greater amounts of space for the same functions.

Non-parallel treatment of parameters also occurs if DEBs for various categories vary in stringency. For example, if the DEBs for attached houses are relatively more stringent than for unattached houses, there is an incentive to build unattached homes in place of attached ones. In this case, this incentive would result in an increase in overall energy consumption because unattached houses use more energy per square foot.

RARG suggests that one way to align the treatment of parameters in the DEB and the DEC is through use of reference building designs. Under this approach, to determine, (under the performance implementation path), whether a building design is in compliance with BEPS, the SET would be applied to the proposed design and to the corresponding reference design. The same values would be used for the DEB parameters in both applications of the SET. Just as there are currently separate budgets for each building type and major climate zone, DOE would have to maintain a catalogue of reference designs. This could include reference designs for a few different size (square footage) categories and allow finer adjustments for size by interpolating the nearest Design Energy Budgets.

This approach would reduce the non-parallel treatment of DEB parameters that appear in the SET. In addition to reducing accidental inequities and perverse incentives, this approach allows much greater flexibility in the further development and adjustment of the BEPS standards. The budget tables published in the NOPR implicitly embody the Standard Evaluation Technique, including any errors or idiosyncracies of the current version, and the weighting factors selected by DOE as of the time the tables were published. Any alternative evaluation technique that is developed must mimic the SET in order to be consistent with the tables, and any revisions in the SET or the weighting factors will necessitate amending the tables. Under the alternative format, much more flexibility is achieved. Evaluation techniques and weighting factors become tools for comparing building designs with reference designs; these tools could be revised as needed without disturbing the basic standards. An added advantage is that the reference building designs could easily be used to develop model building codes for those buildings that will demonstrate BEPS compliance through this path instead of through a performance path.

One apparent disadvantage of the reference design approach is that it would not be possible for DOE to publish energy level tables.

However, these tables are meaningless by themselves; they can only be compared with a Design Energy Consumption generated by the Standard Evaluation Technique. Reference building designs may be more effective illustrations for building designers of the operation and requirements of BEPS than are numerical tables.

C. The Use of a Noncompliance Fee

The alternative format suggested above allows some improvement in the treatment of Design Energy Budget parameters. However, the Design Energy Budgets cannot provide the incentive for appropriate energy conservation in every case because some characteristics will not be completely specified or perhaps might be excluded altogether. As a result, the standards will always be too lax for some buildings while they are too stringent for others which fall in the same general categories. As discussed in Part II of this Report, nonbinding standards may serve as a false "seal-of-approval" and stifle the development of more energy efficient designs unless the regulation clearly states that these are minimum standards. On the other hand, overly binding standards will force energy conservation design beyond the cost-effective level (such as too many layers of window glazing, etc.). For various individual buildings, therefore, the social cost of BEPS will exceed the benefits.

Faced with a similar situation in setting fuel-economy standards for automobiles, Congress decided to allow averaging within a manufacturer's fleet, allowing manufacturers to improve average fuel economy in the least-cost manner. The need for such averaging may be even greater in the case of building energy use, because each building is different, but the atomistic structure of the building industry may effectively preclude an averaging scheme such as that used for automobile energy standards.

RARG urges DOE to look for ways to introduce flexibility for complying with BEPS. It might be possible to find some method of averaging the performance of more than one building in determining compliance. The use of a graduated noncompliance fee is also suggested by the automobile fuel economy standards. This would allow builders the option of paying a fine when, because of micro-climate or other individual circumstances, full compliance was not cost-effective. These possiblilities are discussed in more detail in Appendix III.

In view of the difficulty of setting Design Energy Budgets that are accurate and efficient in every case, RARG also suggests that DOE examine alternative standards that are somewhat less ambitious than the proposed standards. Rather than seeking the minimum life-cycle cost point, standards could be set at a minimum acceptable level of energy efficiency; that is, at a level sufficient to prevent construction of buildings lacking insulation or other basic energy-saving features. As long as such standards were clearly labelled "minimum acceptable", they should not lower the level of energy performance in a building through the false "seal-of-approval" effect discussed in Part II.

V. IMPLEMENTATION

The substantive standards (e.g., stringency levels) in a regulatory program should not be adopted before it is known with particularity how the program can be implemented. This is especially important in the case of BEPS, where many of the theoretical advantages of performance standards may not be realized in practice, because program implementation must rely on model building codes and other prescriptive or nonperformance-oriented devices. 1/

A. Statutory Requirements

The BEPS program is to be enforced (in nonexempt areas) through either of two processes: (1) a certified state or local building code, 2/ or, in the absence of such a code, (2) an acceptable alternative approval permit process to be administered by state or

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1/ DOE recognizes the inevitable prescriptive aspect to implementation of energy performance standards. See Economic Analysis, p. 4-8: "The process used to establish the residential Standards generated a set of conservation measures that will meet the Standards. This by-product is useful because it provides a method that builders can easily follow to ensure compliance with the Standards. Despite the importance of a performance code rather than a prescriptive code to architects and innovators, most builders prefer to use a prescriptive approach to comply with Standards. For most cases, simple recommendations of insulation and glazing levels will be followed by builders because they are the cheapest way of ensuring compliance. These recommendations are equivalent to the conservation levels used in the prototype analysis."

2/ 42 USC 6834(a)(1) provides that a state must certify either that a local government has a "building control mechanism" which "meets or exceeds" BEPS, or that the state has "a building code or other laws or regulations which provide for the effective application" of BEPS.

local authorities. 1/ The federal department administering BEPS -- currently HUD rather that DOE -- would determine exempt areas (those in which there is insufficient construction to warrant "the costs of implementing" BEPS), 2/ would certify building codes (which must also be state-certified), and would review alternative approval processes. Moreover, the Act requires that the administering department periodically review and "provide for updating" BEPS. 3/

The final standards will apply to all new federal buildings 4/ (accounting for approximately 6% of yearly commerical construction) 5/ and to all new federally subsidized or insured housing programs 6/ (accounting for some 15% of yearly housing starts). 7/ Even without congressional approval of the additional sanction mechanism, these provisions may cover enough of the building market to induce most designers to adopt BEPS. Thus, even if Congress does not approve sanctions, it may be necessary that the department administering BEPS develop equivalent building codes and/or other easily implementable compliance techniques.

1/ 42 USC 6834(a)(2) and 6834(b) provide that a building complies with BEPS if so determined in an "applicable approval process" administered by the appropriate state or local agency.

2/ 42 USC 6834(a)(13).

3/ 42 USC 6833(c).

4/ 42 USC 6835.

5/ Draft Environmental Impact Statement Supplement, p. 3-18.

6/ Section 252, National Energy Conservation Policy Act of 1978. This includes Federal Housing Administration and Farmers' Home Administration programs.

7/ Draft Environmental Impact Statement Supplement, p. 3-18.

There are currently no sanctions against non-federal or federally subsidized or insured buildings that are in nonexempt states and localities without a certified building code and that have not complied under an alternative approval permit process. However, the Act empowers Congress to impose, through joint resolution within 90 legislative days after the final standards are promulgated, a general enforcement sanction. 1/ The sanction involved is withholding all "Federal financial assistance" for new buildings in such non-complying areas, with such assistance broadly defined to include any loan made or bought by a financial institution subject to federal regulation 2/ (which accounts for 66% of all construction annually). 3/ In effect, the congressional decision on whether to apply this "sanction" is a decision on whether to enforce BEPS federally against all buildings by requiring state and local adoption of the standards.

B. DOE's Approach to Implementation and Enforcement

Although DOE does not currently have statutory authority or responsibility for implementing BEPS, it has formally agreed with HUD to analyze these issues, which are discussed in Chapter 5 of the NOPR. As noted several times in the NOPR, this discussion is preliminary and very tentative.

1/ The Act provides that the final standards will become effective within a year after they are promulgated. There can be no actual enforcement until the date of effectiveness.

2/ 42 USC 6832(7), 6833(a)(1), 6834(a)(c). Of course, Congress could also enact legislation during the 90-day layover period, or later, providing for less draconian alternative sanctions.

3/ Draft Environmental Impact Statement Supplement, p. 3-18.

First, the NOPR discusses establishing prescriptive building codes or component performance requirements that would assure compliance with BEPS energy budgets. DOE is attempting to develop model codes, which it recognizes "probably is beyond the analytical capabilities of most states." 1/ Although the NOPR states that DOE will prequalify codes and other control processes "to the extent feasible" before the BEPS become effective, 2/ it seems most unlikely that DOE will have developed suitable building codes, by building type and for 78 climates, by August 1981, or that states and localities will have adopted them.

Second, DOE suggests having design professionals certify compliance, using manuals of recommended practice and/or simple calculation methods. These techniques could be used under either the certification procedure or the alternative approval process. Again, it seems doubtful that such equivalency approaches will be completed and widely available by August 1981.

Third, DOE suggests requiring a "performance path" option, under which a design could be evaluated for its building-wide energy use. Such an option would involve calculating a building's Design Energy Consumption (probably on a computer), using a Standard Evaluation Technique (SET) approved by DOE. 3/

Fourth, DOE suggests requiring that energy standards have the same enforcement standing as health and safety provisions in

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1/ NOPR, p. 5-6.

2/ NOPR, p. 5-7.

3/ In the previous Part, RARG suggests an alternative "performance path" option that would involve applying the SET to a reference building design.

building codes, and that buildings be inspected periodically during construction.

DOE properly stresses the lack of training of local building officials in energy performance concepts, and notes the small size, and multiple duties, of code enforcement staffs. 1/ It is partly for these reasons that DOE suggests that designs be certified by private design professionals, with review by local agencies. Even rigid certified building codes seem likely to tax the resources of local code enforcement agencies. More flexible performance path options seem certain to strain those resources, as well as the resources of design professionals called on to make individual building certifications.

If implementation is to be successful, builders and building material suppliers must respond. DOE apparently does not expect significant bottlenecks in the supply of appropriate building materials. 2/ The Economic Analysis concludes, however, that "small builders," who collectively provide 70% of new residential starts, "will represent a difficult hurdle for implementation of energy conservation standards since they are so small, so scattered, and so risk-averse." 3/

1/ NOPR, p. 5-4.

2/ Economic Analysis, Appendix F.

3/ Ibid. p. F. 42. Small builders are apparently defined as builders who build less than 100 units a year. Ibid. p. F. 41. Collectively such builders are said to average 8 units a year. Ibid. p. F. 42.

C. The Costs of Implementation

Properly implementing the BEPS program would require a substantial committment of resources from state and local agencies, the administering federal department, designers, and builders. Congress, recognized that implementation would be costly, for it authorized the administering federal department to assist in implementing BEPS by making grants and providing technical assistance to state and local governments. 1/ However, Congress has not yet appropriated any funds for these purposes. Neither has it authorized subsidies for any of the other affected groups. 2/

The cost of implementation and enforcement is simply one facet of the total costs of the BEPS program. Hence, in assessing the cost of BEPS, the indirect costs of implementation -- such as increased design, inspection, and paperwork costs -- should be considered along with the direct costs of marterials and labor. Indeed, implementation costs may be especially important because they must be incurred even if the BEPS are not constraining.

The Economic Analysis includes an estimate of "implementation and enforcement" costs of BEPS. However, this estimate appears to be far too low, in part because it does not adequately reflect the total burden on the private sector.

1/ 42 USC 6836, 6837.

2/ DOE is also considering using the existing State Energy Conservation Plan Program (under the Energy Policy and Conservation Act of 1975, 42 USC 6321 et seq.) as a mechanism for providing assistance in administration of BEPS. NOPR, p. 5-7.

The estimate in the Economic Analysis was obtained from HUD, which examined cost estimates of similar government programs and held discussions with local building inspectors and code officials. 1/ HUD estimated that code development and certification and inspector training would cost $40 million (with another $30 million to $50 million due to state energy codes that would exist without BEPS). It estimated that annual incremental enforcement costs due to "plan review and site inspection" would be $54 million ($0.03/sq. ft. for commercial buildings and $10 per single-family home).

These estimates appear to include only costs incurred by governmental agencies in developing and certifying codes and in training and paying building inspectors. 2/ They do not appear to encompass the increased costs that must be borne by the private sector to show compliance with BEPS. These would include the cost of becoming familiar with, and complying with, possibly complex prescriptive or component performance equivalent building codes; utilizing manuals of recommended practice or other noncode equivalency approaches; or undertaking the computer analysis required by the SET or by other performance path approaches. Nor are these increased design costs considered in the section of the Economic Analysis on capital costs of BEPS. Of course, builders in jurisdictions that already have energy codes would incur a less substantial

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1/ Economic Analysis, p. 5-29.

2/ Economic Analysis, p. 5-29 to 5-32.

additional expense under BEPS. As noted in Part II above, 36 states currently have authority to establish comprehensive energy codes.

The NOPR's Standard Evaluation Technique (SET) is currently the only approved method for demonstrating compliance with BEPS. If final standards are promulgated and become effective as scheduled, then federal buildings and federally insured and subsidized buildings will be required to use this technique unless equivalent codes and/or manuals of recommended practice have been developed. Unfortunately, the SET appears likely to be costly to operate, because it involves using as many as three complex subprograms. The SET will be useful for no purpose other than demonstrating compliance with BEPS. The SET only simulates design energy use, not actual use, primarily because it assumes certain standard operating conditions, and also because it does not (as now developed) encompass certain design and siting factors that affect energy use. DOE hopes to develop additional subprograms before promulgating final BEPS. There is, however, necessarily some tension between the objective of taking all relevant factors and circumstances into account and the objective of simplicity.

Even as estimates of governmental costs, the figures in the Economic Analysis appear quite low. For example, the estimate of $40 million total one-time costs for plan development seems low when compared to the amount of funds already spent by DOE in developing BEPS. Just since mid-1977, when DOE took over the program from HUD, nearly $30 million has been expended. 1/ This figure does not

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1/ DOE's budgets show that the BEPS standards development program costs have been as follow: 1977-$5 million; 1978-$10 million; 1979-$12.3 million. The budget for fiscal 1980 is $6 million, and the tentative budget for fiscal 1981 is $6.8 million.

include the cost of collecting data under Phase I and Phase II of the BEPS program before it was transferred from HUD.

Moreover, it seems unduly optimistic to assume that the one-time cost of developing and certifying BEPS equivalency codes and training inspectors would be only twice the cost of implementing state energy codes. 1/ Up to now the federal government has been unable to develop a set of either component or prescriptive codes that are equivalent to the proposed standards, even though a workable component performance code (ASHRAE 90-75) exists and is relatively easy to make more or less stringent.

Finally, in addition to the direct dollar costs of implementation, there may be more subtle costs associated with such precise federal specification of building energy performance. This cost is likely to increase with implementation complexity and direct dollar implementation costs.

D. Conclusion

Much work remains to be done before a BEPS program can be implemented. The only current method of ascertaining compliance, the Standard Evaluation Technique, appears inadequate and costly. There is no publicly visible progress in the huge task of developing equivalency codes and other inexpensive means of determining compliance.

Implementation represents a significant program cost beyond the increase in direct construction costs due to BEPS and is the

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1/ It seems similarly optimistic to assume that 90% of the residential and 60% of the commerical buildings would use equivalent prescriptive compliance procedures, and that the remainder would use equivalent component performance procedures.

crucial step in translating the potential energy savings of the performance standards into actual energy savings. Unfortunetely, it is not clear that the problems arising in implementation can be overcome without undercutting the fundamental advantage of performance standards. It will be difficult to develop building codes or other equivalency approaches that both capture the flexibility and subtlety that make performance standards desirable and also are cost-effective when utilized by builders and state and local building officials. RARG believes it is inappropriate to issue final BEPS until and unless these implementation difficulties are overcome and there is an opportunity for public comment on a complete proposed implementation plan (including model codes and manuals of recommended practice).

VI. CONCLUSION

The desirability of performance standards stems from their flexibility. Specifying an end result allows the means of meeting that result to vary according to differences in preferences and characteristics in specific cases. Thus, when the objective of government intervention is to achieve comprehensive, optimum changes in behavior, performance standards are theoretically more appropriate than prescriptive standards because they will introduce fewer inefficiencies and rigidities into the system. Building codes have traditionally been prescriptive, or have set performance standards for components rather than whole buildings. The enormous complexity of buildings and building markets makes the development of comprehensive performance standards an extremely difficult task.

The BEPS legislation requires performance standards, specifically prohibiting issuance of standards that specify building materials or other design elements. Given the mandate to use a performance approach, DOE has sought to develop standards that are comprehensive and, within bounds of practicality, optimum, and has explicitly termed the single-family residential standards as corresponding to "minimum life-cycle cost."

In this Report, RARG has identified several major difficulties with the proposed standards, some of which can be corrected by DOE and some of which are inherent in applying the mandatory performance approach to buildings:

-- The selection procedures and data base, particularly for the commercial standards, were not adequate to produce standards that may be said with assurance to result in maximum net benefits to building owners or the nation as a whole. The data relied on are now four years old but concern a market that during this time has probably undergone significant change. RARG does note that one reason that the standards may not be optimal -- that they relate only to the design stage and do not account for differences in operating conditions -- is a statutory requirement which DOE cannot avoid.

-- As is true of the procedures for selecting the standards, the choice of weighting factors also is not addressed by statute. Basing the factors on full marginal social cost, as DOE proposes, will not lead to the proper mix of fuels. The conceptually correct basis on which to choose the factors is that portion of full marginal social cost not already accounted for in the market. If a major market failure is myopia, DOE will probably be unable to develop weighting factors that even approximate the correct result, given the great amount of information it would need to do so.

-- Another fundamental problem casting doubt on the BEPS approach itself involves variance in building energy use. In developing performance standards, there is a tension between seeking to tailor the standards to differences in building use, and setting only a few standards in order to provide maximum incentives to save building energy. RARG questions DOE's decision to set separate budgets depending on what type of fuel is used for space-heating in houses. In addition, DOE should explicitly explain the basis for choosing its Design Energy Budget parameters. RARG does not have any general solutions to the variance problem, however, because the tension is inherent in the approach itself: standards that minimize life-cycle cost for one building could be either too stringent or too lax for another.

In view of the uncertainties and fundamental problems discussed above, RARG urges DOE to undertake more research and a comprehensive reassessment of the entire BEPS approach. Our specific proposals on legislative consultations and timetables for further work are presented in the last section of Part I of the Report.

If DOE is not released from its mandate to issue final BEPS, it might at least consider modifying the standards. It is likely that the inefficiency introduced by having a standard that is too stringent for a building is greater than the efficiency loss from a standard that is commensurately too lax for that building. That is, it is worse to impose unnecessary building costs, which the builder cannot avoid, than to specify too lax design requirements; lax standards become less relevant if the builder exceeds them, as he might do simply in response to higher energy prices or other conservation programs.

This suggests that building energy standards might be developed not to achieve optimum energy savings for every building, but, rather, to prohibit clear instances of energy waste. Prescriptive standards may be better suited for such a function in the building energy context;

such standards would simply require certain minimal amounts of insulation and other design practices that are clearly efficient in all but a handful of instances. This alternative would require statutory amendment.

The performance approach can also be used to eliminate grossly inadequate design practices by setting standards that specify acceptable performance levels, without seeking to minimize life-cycle costs for the average or typical building in each category. Like minimal prescriptive standards, in most cases this will avoid standards that are excessively stringent for particular buildings. Another reason for purposely setting less stringent standards is the great uncertainty in the data base and selection procedures. RARG stresses that reducing the stringency of BEPS in no sense "solves" the problems pointed out in this Report; it simply avoids some of them by reducing the effect of the program.

If stringency were reduced, it would be very important that the BEPS not be characterized as minimum life-cycle cost, or otherwise "optimal," standards. Proper characterization of the standards as only "minimum acceptable" would go far toward avoiding the perverse "seal of approval" affect, discussed in Part II, that might otherwise result from loose standards. Given the difficulties and uncertainties inherent in mandatory building energy performance standards, moving explicitly toward less stringent standards appears in harmony with the statutory objective of achieving "maximum practicable energy savings" through BEPS. Public information programs and building efficiency labelling could encourage conservation beyond the minimum acceptable level.

Another alternative to a national, mandatory BEPS program would be to implement BEPS only on a pilot basis, perhaps only for federal buildings or for states that volunteer. However, the pilot state approach would appear to require some legislative amendment of the Act to release DOE from its present obligation to issue final BEPS by August 14, 1980. Even without a pilot approach, RARG is convinced that in view of the difficulties identified in this Report, it would be preferable not to require final standards by that date, and instead to allow DOE additional time to undertake a thorough reassessment of BEPS.

Appendix I

BEPS VS. CAFE STANDARDS

The characteristics of automobiles and the auto industry that have made the Corporate Average Fuel Economy (CAFE) program feasible are significantly different from the characteristics of buildings and the building industry. The following comparison reveals several reasons why the BEPS program may not be feasible.

Greater Variety. Cars are built in a limited number of models and are used in similar ways. By contrast, virtually every building is unique, often being tailored to a particular site or to particular functions. The conditions of building use are far more varied and uncertain than is true of automobiles, and may have a profound effect on the optimal design of a building's energy systems. For instance, a building that ordinarily would require heating may require cooling instead if it is used to house computers.

Varied Fuels. Selecting a measure of energy-efficiency is fairly easy in the case of automobiles. Fuel economy has a direct effect on the demand for gasoline, and the social premium for gasoline is uniform and can be estimated. Measuring energy-efficiency is much more difficult for buildings, which use three fuels -- oil, gas, and electricity -- whose relative value is difficult to determine. This is particularly true with respect to electricity, the cost of which varies from site to site as well as with the season and the time of day.

Design-Stage Testing. To determine compliance with automobile fuel economy standards, the government need not test every car; testing prototypes of each model is adequate. To determine compliance with BEPS, the government must evaluate every building before it is built.

More Producers. The automobile fuel economy standards need only be enforced against five domestic manufacturers and a handful of importers. BEPS would be enforced against thousands of firms in what is the nation's most diverse and least concentrated major manufacturing industry. (In addition, enforcing BEPS will involve several layers of government.)

Perhaps the major implication of these characteristics is that flexibility through averaging is possible with the CAFE standards but not with performance standards for buildings. Under the CAFE standards, achieved fuel economy is averaged over the entire fleet of a manufacturer and across adjacent model years. This gives manufacturers flexibiity to determine the least cost method of achieving a given level of average fuel economy and tends to cancel out errors in estimating the appropriate standards for each model and the actual fuel economy achieved for each model. If the manufacturer does not achieve fuel economy requirements, a graduated noncompliance fee is imposed. By contrast, the characteristics of buildings and the building industry make averaging impractical for a BEPS program. As a result, a building that does not meet its budget cannot be brought into compliance by borrowing energy savings from another building. (Further, as DOE has proposed implementing BEPS, it is not possible to obtain a variance by paying a fee.)

It should also be noted that the CAFE standards are becoming obsolete because consumers are demanding automobiles that on average are more efficient than the government standards. Although it has taken a few years for the market to respond to higher gasoline prices, consumer demand is now the driving force for greater vehichle fuel efficiecny. (It may be that the technological push generated initially through the CAFE program has been responsibl in part for the auto industry's present ability to increase fuel economy.) RARG suspects that similar movement is occuring in the building market as buyers and builders become more sensitive to energy costs. Yet, while obsolete automobile standards simply become non-binding and virtually costless, the same is not true of BEPS. Because of the manner in which they are enforced and the fact that no averaging is allowed, obsolete building energy standards may result in few benefits but still impose large social costs.

The foregoing comparisons illustrate the fundamental problems that are faced in attempting to develop and implement building energy performance standards. Because these problems involve the basic nature of building energy use, building design, and the building industry, they can be viewed as inherent in the BEPS approach, raising the question whether the approach itself is an appropriate and feasible way to encourage greater energy-efficiency in buildings.

APPENDIX II

WEIGHTING FACTORS

This appendix explores in mathematical terms the interaction of the incentives of the market with those implicit in the BEPS constraint. It uses a cost-minimization model to find weights that will provide incentives to produce buildings that minimize the social cost of achieving a given amenity level.
The private objective function in the model incorporates a discount factor for operating costs, which enables the model to examine market failures that cause the designer to be myopic about energy expenditures, as well as market failures due to mispricing of fuels. The model is an oversimplification of the effect of BEPS on actual behavior--even so, it illustrates the complexity of the weighting factors question.

$f(G,O,E,X)$ = amenity function for a building

f^* = desired amenity level

G = design consumption of gas
O = " " " oil
E = " " " electricity
X = vector of other attributes of the building, including conservation features

p_g = price of gas P_g = social cost of gas
p_o = " " oil P_o = " " " oil
p_e = " " electricity P_e = " " " electricity
P_x = vector of prices of other attributes of the building = the social costs of those attributes (no mispricing)

The amenity constraint is:

$$f(G,O,E,X) \geq f^*$$

The objective function of the builder is to minimize costs:

$$p_gG + p_oO + p_eE + P_xX$$

To allow for market failures that lead the building designer to be myopic about operating costs, we introduce a discount factor, α, $0 \leq \alpha \leq 1$, to modify the objective function of the builder:

$$\alpha(p_gG + p_oO + p_eE) + P_xX$$

In contrast, the social objective is to minimize total social costs:

$$P_gG + P_oO + P_eE + P_xX$$

The builder will choose G, O, E, and X to minimize the Lagrangian:

$$L = \alpha(p_gG + p_oO + p_eE) + P_xX + \lambda(f(G,O,E,X) - f^*)$$

where λ is the shadow price of the amenity constraint.

Gas consumption will be chosen such that:

$$\frac{\partial L}{\partial G} = 0$$

$$\lambda\frac{\partial f}{\partial G} + \alpha p_g = 0$$

$$\lambda\frac{\partial f}{\partial G} = -\alpha p_g$$

The relative consumption of gas and electricity will be chosen such that:

$$\frac{\frac{\partial f}{\partial E}}{\frac{\partial f}{\partial G}} = \frac{\alpha p_E}{\alpha p_G} = \frac{p_E}{p_G}$$

In contrast, at the social optimum:

$$\lambda \frac{\partial f}{\partial G} = p_G$$

and $$\frac{\frac{\partial f}{\partial E}}{\frac{\partial f}{\partial G}} = \frac{p_E}{p_G}$$

With BEPS, the builder faces the additional constraint:

$$w_G G + w_O O + w_E E \leq B$$

w_G = the weighting factor for gas
w_O = " " " " oil
w_E = " " " " electricity

B = the assigned Design Energy Budget

The Lagrangian is now:

$$L^* = \alpha(p_G G + p_O O + p_E E) + P_X X + \lambda(f(G,O,E,X) - f^*)$$
$$+ \gamma(w_G G + w_O O + w_E E - B)$$

where γ is the shadow price of the BEPS constraint.

This Lagrangian can be rewritten:

$$L^* = \lambda(f(G,O,E,X) - f^*) - \gamma B + (\alpha p_G + \gamma w_G)G$$
$$+ (\alpha p_O + \gamma w_O)O + (\alpha p_E + \gamma w_E)E + P_X X$$

Gas consumption will be chosen such that:

$$\frac{\partial L^*}{\partial G} = 0$$

$$\lambda \frac{\partial f}{\partial G} = \alpha p_G + \gamma w_G$$

The relative consumption of gas and electricity will be such that:

$$\frac{\frac{\partial f}{\partial E}}{\frac{\partial f}{\partial G}} \quad \frac{\alpha p_E + \gamma w_E}{\alpha p + \gamma w_G}$$

If BEPS is to result in optimal behavior, then we want this expression to equal:

$$\frac{P_E}{P_G}.$$

so $\frac{w_E}{w_G} = \frac{P_E - \alpha p_E}{P_G - \alpha p_G}$

Thus the relative weights should be proportional to the difference between the social cost of each fuel and its perceived price.

Several possible cases can be distinguished:

Condition	Prescription
1: $P = p$; $\alpha = 1$	No market failure; no need to intervene. (weights = 0)
2: $P = p$; $\alpha = 0$	All operating costs are ignored; set weights equal to prices.
3: $P \neq p$; $\alpha = 1$	Set weights equal to the social premiums, P-p.
4: $P \neq p$; $\alpha = 0$	Set weights equal to the full social costs, P This is DOE's proposed method for setting final weights.
5: $P \neq p$; $0 < \alpha < 1$	Set weights equal to the difference between social and perceived private cost: $P - \alpha p$. This is the most general case.

Note that to produce the socially optimal behavior, DOE must not only set the relative weights properly, but also must be concerned about the value of γ. This term has units of dollars per DEB unit, and represents the shadow price of the BEPS constraint. One way to control this shadow price is to buy and sell DEB units at a fixed dollar price. An upper limit can be placed on the shadow price by imposing a non-compliance fee for exceeding BEPS. These options and others are briefly discussed in Appendix III.

Appendix III

FLEXIBILITY IN COMPLIANCE

The BEPS standards are mandatory and absolute in the sense that a building to which BEPS applies effectively cannot be built if it does not meet its assigned Design Energy Budget. If it were possible to tailor the energy budgets for each building so as to require only cost-effective conservation investments, it might be appropriate that builders be forbidden to build structures not meeting the BEPS standards. However, given that the Design Energy Budgets are impercise and will be too stringent in some cases and too lax in others, such mandatory performance standards may prevent builders from achieving cost-effective reductions in design energy use.

In this Appendix, RARG lists some methods that could introduce compliance flexibility into the performance path of a standard program, in order to improve the overall cost-effectiveness of the standards. RARG recognizes that some or all of these methods may not be permissible with the Act authorizing BEPS. Moreover, further examination may reveal that some of the methods are not feasible in the context of building energy reference standards. RARG presents these ideas in order that DOE may consider them both as it reviews its proposed standards and as it reassesses the entire BEPS approach and develops legislative recommendations for Congress.

Compliance Averaging

The simplest method of introducing flexibility into compliance with a performance standard is to allow averaging. This is done, for example, in the Corporate Average Fuel Economy (CAFE) standards for automobiles, discussed also in Appendix I. As noted there, the small size of most firms in the building market limits the extent to which "corporate" averaging can operate. Still, there may be some room for such averaging in BEPS, and the illustration below demonstrates some of its potential advantages.

The proposed BEPS standards set different budget levels for attached and unattached houses. However, no distinction is currently made for semi-attached houses. A house on the end of a row is treated as attached and must meet the same standard as the houses in the middle, even though the standard is effectively more stringent for the end house.

Rather than require the builder of a town-house project to put extra, and not necessarily cost-effective, conservation features in the end houses of each row, the BEPS program could be modified to allow the project (or row) to meet the standard on average. This would allow the same amount of energy to be saved, but at a lower cost. It is not much different from the effective averaging that is implicit in the standard for multifamily residential buildings.

Marketable Rights

Under a marketable rights approach, averaging could be allowed much more broadly. A builder would receive "rights" equal to the amount of the building's Design Energy Budget (DEB). He would also calculate the building's Design Energy Consumption (DEC). The regulations would require the builder to surrender, before building, the number of DEB "rights" equal to the DEC.

This program would differ from the BEPS program in that the DEB rights could be traded; that is, transferred from one building to another, or from one builder to another. The advantage of this feature is that it allows a given level of energy savings to be achieved in the least-cost way. If it is cheaper, or for other reasons preferable, to exceed the DEB in one building and undershoot in another, then the exchange of rights permits this adjustment, without relaxing the aggregate total Design Energy Budget.

Design Energy Consumption Tax/Rebate

One further refinement of the marketable rights approach described above would be to have DOE buy and sell DEB rights at a fixed price. The logical price to set would be the value of those rights to society; i.e., the external costs of energy use. Under this approach, a builder would simply receive a bill or a check proportional to the amount by which his Design Energy Consumption exceeds his assigned Design Energy Budget. This is equivalent to putting a tax on DEC, with the price of rights representing the marginal tax. The tax would be effectively rebated in the form of the initially distributed Design Energy Budget rights.

A Non-Compliance Fee

Another variant on the above proposal is for DOE to sell extra DEB units, but not to buy them. In this case, an excessively large DEC would be taxed for its excess, but no subsidy would be available for doing better than the standard. This option could be implemented by eliminating the absolute mandatory aspect of the program, and instead imposing a graduated non-compliance fee on buildings that exceed their budgets.

Department of Energy
Washington, D.C. 20585

395-5046

APR 3 0 1980

Mr. George Eads, Member
Council of Economic Advisors
Old Executive Office Building
Room 314
Washington, D. C. 20506

Dear Mr. Eads:

DOE appreciates the views and opinions expressed in the April 30 report of the Regulatory Analysis Review Group (RARG) concerning the Notice of Proposed Rulemaking for Energy Performance Standards for New Buildings. As noted by RARG, the proposed rule was developed in response to a Congressional mandate.

RARG recognizes that its role is normally limited to commenting on a proposed rule in relationship to its enabling legislation. In this instance, however, a substantial portion of the Report questions the need for enacted legislation and therefore is outside the scope of the proposed rule.

The RARG report's assertions and conclusions remain undocumented. For example, RARG asserts that no regulation is needed to require the design of energy efficient new buildings because market forces have already brought about this result. The assertion implies that there may be no need for the legislation which mandates the development of standards. Without further documentation, however, this assertion is untenable.

Since a proposed rule has been issued, DOE believes it would be premature and inappropriate to provide ad hoc responses to RARG's specific concerns and criticisms to be published in an appendix to the Report. Instead, DOE intends to respond to the points raised as part of DOE's response to all public comments received.

Sincerely,

T. E. Stelson

T. E. Stelson
Assistant Secretary
Conservation and Solar Energy

Appendix VIII

Comments of the American Consulting Engineers Council

THE AMERICAN CONSULTING ENGINEERS COUNCIL
1015 15TH STREET, N.W.
WASHINGTON, D.C. 20005

202-347-7474

MR. CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE, MY NAME IS DONALD G. CARTER. I AM A PROFESSIONAL ENGINEER IN PRIVATE PRACTICE FROM SILVER SPRING, MARYLAND, AND CHAIRMAN OF THE ENERGY COMMITTEE FOR THE AMERICAN CONSULTING ENGINEERS COUNCIL (ACEC). I APPEAR BEFORE YOU TODAY ON BEHALF OF THE COUNCIL REPRESENTING 3,600 PRIVATE ENGINEERING FIRMS WITH OVER 100,000 TOTAL EMPLOYEES.

OUR COUNCIL AND OUR MEMBERS ARE DEEPLY CONCERNED WITH THE DEPARTMENT OF ENERGY'S PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS (BEPS). WE HAVE MONITORED THE DEVELOPMENT OF BEPS FOR SEVERAL YEARS AND OUR MEMBERS HAVE PARTICIPATED IN THE RESEARCH EFFORT ON WHICH THE STANDARDS ARE PREDICATED. WE ARE KNOWLEDGEABLE OF THE TECHNICAL AND POLICY-LEVEL PROVISIONS CONTAINED IN BEPS. WE ARE ALSO FAMILIAR WITH THE REQUIREMENTS OF PUBLIC LAW 94-385 (THE ENERGY CONSERVATION AND PRODUCTION ACT OF 1976), AS IT CONCERNS THE BEPS INITIATIVE.

I WOULD LIKE TO BEGIN BY EXPRESSING OUR SUPPORT FOR THE CONCEPT OF A PERFORMANCE STANDARD FOR ENERGY CONSCIOUS DESIGN. ENGINEERS, MORE SO THAN ANY OTHER GROUP, ARE CONTINUALLY CALLED UPON TO SOLVE ENERGY-RELATED PROBLEMS IN BUILDINGS, BOTH NEW AND OLD. BY VIRTUE OF THEIR UNIQUE TRAINING AND EXPERIENCE, PROFESSIONAL ENGINEERS POSSESS INTIMATE KNOWLEDGE OF MECHANICAL AND ELECTRICAL REQUIREMENTS FOR LIFE SUPPORT SYSTEMS IN BUILDINGS. THE DEMAND FOR ENERGY TO OPERATE THESE SYSTEMS NECESSITATES A THOROUGH

UNDERSTANDING OF HEAT LOSS/HEAT GAIN CHARACTERISTICS OF ALL BUILDING COMPONENTS. INHERENT IN THE PROCESS OF DESIGNING AND CONSTRUCTING NEW ENERGY-EFFICIENT FACILITIES IS THE CONCERN FOR USABLE AND EFFECTIVE STANDARDS FOR ALL PHASES AND ASPECTS OF THIS WORK.

WE WOULD LIKE TO POINT OUT THAT THE BEPS, AS PROPOSED, ARE NEITHER USABLE OR REASONABLE IN THEIR PRESENT FORM. THE 61-PAGE PROPOSAL, ALTHOUGH CONCEPTUALLY SOUND, IS BASED UPON UNCONFIRMED DATA, A SEVERELY LIMITED RESEARCH SAMPLE, VAGUE AND SOMETIMES ERRONEOUS INTERPRETATIONS OF THE CONGRESSIONAL MANDATE, AND JUDGEMENTS WHICH WE FIND QUESTIONABLE AND EVEN CHALLENGEABLE.

WE FIRMLY BELIEVE THAT:

+ DOE MUST EXPAND ITS RESEARCH EFFORT TO ASSURE THE BUILDING COMMUNITY THAT THE ENERGY BUDGET LEVELS ESTABLISHED IN THE PROPOSED RULE ARE PRACTICAL AND REASONABLE.

+ DOE MUST COMPLETE ONGOING RESEARCH RELATED TO LIFE CYCLE COST ANALYSIS FOR COMMERCIAL BUILDINGS AND EXPEDITE REMAINING RESEARCH ON CLIMATE CLASSIFICATIONS, DEGREE DAY VARIABLES, STANDARD BUILDING OPERATING CONDITIONS, REGIONALIZED FUEL WEIGHTING FACTORS, SIMPLIFIED STANDARD EVALUATION TECHNIQUES, AND OTHER ASPECTS OF THE BEPS UNDERTAKING WHICH WERE INCOMPLETE AT THE TIME OF THE PROPOSED RULEMAKING AND REMAINS INCOMPLETE TODAY.

+ DOE MUST HAVE ADDITIONAL STAFF RESOURCES TO ADMINISTER AND COORDINATE THE BEPS PROGRAM. UNTIL NOW, THE ENTIRE STAFF RESPONSIBILITY FOR BEPS HAS BEEN IN THE HANDS OF ONLY SIX PEOPLE.

+ DOE MUST CAREFULLY DESIGN A WORKABLE IMPLEMENTATION PROGRAM AND SEEK COUNSEL FROM STATE AND LOCAL LEGISLATORS AS TO THE DEGREE OF IMPLEMENTATION POSSIBLE IN ALL REGIONS OF THE COUNTRY. THIS WILL INVOLVE CODE OFFICIALS, BUILDING INSPECTORS, AND DESIGN PROFESSIONALS WHO UNDERSTAND BEST THE COMPLIANCE SYSTEMS NOW IN PLACE FOR RELATED CODES AND STANDARDS.

+ DOE MUST STIMULATE THE DEVELOPMENT OF TECHNICAL SEMINARS ON BEPS FOR THE PURPOSE OF EDUCATING DESIGN PROFESSIONALS AND OTHERS WHO WILL BE FORCED TO EMBRACE AND COPE WITH THE STANDARDS.

IN ORDER TO ACCOMPLISH ALL OF THE ABOVE, DOE MUST HAVE ADDITIONAL TIME. THE PRESENT MANDATE TO PUBLISH BEPS IN FINAL FORM (AUGUST 14, 1980) MUST BE RELAXED TO FACILITATE NECESSARY REVISIONS AND MODIFICATIONS OF THE NOVEMBER 28, 1979, PROPOSAL.

ACEC STRONGLY BELIEVES THAT AT LEAST TWO YEARS OF ADDITIONAL TIME (UNTIL AUGUST OF 1982) ARE NECESSARY TO PRODUCE AN ACCEPTABLE BEPS. ANYTHING SHORT OF THIS WILL SEVERELY COMPROMISE THE IMPACT THE STANDARDS SHOULD HAVE BY CAUSING CRITICAL QUESTIONS OVER

THEIR TECHNICAL ACCURACY AND PRACTICAL APPLICATION. THE DESIGN AND CONSTRUCTION INDUSTRY, THE BUILDING COMMUNITY AT LARGE, AND EDUCATED CONSUMERS WILL NOT SIT STILL WHILE THE GOVERNMENT IMPOSES AN INCOMPLETE AND UNSUBSTANTIATED BUILDING STANDARD ON THE NATION.

THE DEPARTMENT OF ENERGY IS DESPERATELY IN NEED OF TWO ADDITIONAL YEARS IN WHICH TO REVISE AND EVALUATE BEPS BEFORE IT CAN BE PRODUCED IN FINAL FORM. DOE SHOULD RECOGNIZE THIS FACT AND ACKNOWLEDGE ITS RESPONSIBILITY TO THE DESIGN AND CONSTRUCTION INDUSTRY TO PRODUCE A DELIBERATE AND THOROUGH DOCUMENT WHICH CAN BE INCORPORATED INTO TRADITIONAL DESIGN PRACTICE. RAPID IMPLEMENTATION OF A FLAWED BUILDING ENERGY PERFORMANCE STANDARD WILL ONLY HAVE A DISRUPTIVE IMPACT ON AN ALREADY TROUBLED CONSTRUCTION INDUSTRY.

OUR COUNCIL URGENTLY REQUESTS THAT THE SENATE SUBCOMMITTEE ON ENERGY REGULATION IMMEDIATELY RECOMMEND STATUTORY CHANGES TO P.L. 94-385 TO PROVIDE AT LEAST TWO YEARS OF ADDITIONAL TIME FOR DOE TO COMPLETE ITS WORK. LANGUAGE TO ACCOMPLISH THIS EXTENSION ALREADY EXISTS IN THE FY 1981 HUD REAUTHORIZATION LEGISLATION (S.2719 AND H.R. 7262). WE RESPECTFULLY URGE THE MEMBERS OF THIS SUBCOMMITTEE TO RECOMMEND APPROVAL OF THE TWO-YEAR EXTENSION IN ORDER THAT THE BEPS PROGRAM MAY SUCCEED.

MR. CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE, THANK YOU FOR CONSIDERING OUR REMARKS ON THIS IMPORTANT ENERGY PROGRAM. I WILL

CONCLUDE MY ORAL STATEMENT AT THIS TIME, BUT WOULD ASK THAT THE SUPPLEMENTAL MATERIAL CONTAINED IN OUR PRESENTATION BE INCLUDED IN THE HEARING RECORD.

* * * * *

THE FOLLOWING ARE ITEMS OF CONCERN IDENTIFIED BY THE AMERICAN CONSULTING ENGINEERS COUNCIL WITH REGARD TO THE NOVEMBER 28, 1979, PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS (BEPS).

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1) UNDER THE PROPOSED ALTERNATE APPROVAL PROCESS, DESIGNERS WILL BE ASKED TO "CERTIFY" THAT THEIR DESIGNS COMPLY WITH THE REQUIREMENTS OF THE STANDARDS. THIS PRESENTS A SERIOUS LIABILITY PROBLEM FOR ARCHITECTS AND ENGINEERS.

2) WE ARE CONCERNED THAT THE RESEARCH SAMPLE FOR THE PHASE II RESEARCH EFFORT (168 BUILDINGS) IS TOO SMALL A SAMPLE ON WHICH TO BASE A NATIONAL BUILDING STANDARD.

3) WE BELIEVE THAT THE ONE-YEAR IMPLEMENTATION REQUIREMENT IS MUCH TOO AMBITIOUS AND SHOULD BE RELAXED TO PERMIT ADDITIONAL TIME FOR STATES AND LOCAL GOVERNMENTS TO TAKE APPROPRIATE ACTION.

4) RESEARCH THAT MAY HAVE AN IMPACT ON THE ENERGY BUDGET LEVELS AND OTHER ASPECTS OF THE RULE IS STILL INCOMPLETE AND ONGOING. DATA GENERATED AS A RESULT OF THIS RESEARCH SHOULD BE MADE AVAILABLE FOR REVIEW PRIOR TO FINALIZING THE BEPS.

5) WE BELIEVE THAT DOE SHOULD ELIMINATE THE "WEIGHTING FACTOR" CONCEPT AND REFRAIN FROM ATTEMPTING TO INFLUENCE SOURCE ENERGY CONSUMPTION.

6) WE BELIEVE THAT A "MANUAL OF ACCEPTABLE PRACTICES" SHOULD BE DEVELOPED AND APPROVED AS AN ALTERNATE PATH TO PROVIDING COMPUTER SIMULATIONS. SUCH A DOCUMENT SHOULD BE BASED UPON THE EXISTING ASHRAE STANDARD 90 COMPONENT DESIGN APPROACH.

7) EDUCATIONAL PROGRAMS FOR DESIGN PROFESSIONALS, CODE OFFICIALS, LEGISLATORS, AND OTHERS SHOULD BEGIN IMMEDIATELY. A COMPREHENSIVE, DOE SPONSORED, EDUCATIONAL EFFORT IS VITAL TOWARD "EFFECTIVE IMPLEMENTATION" OF THE BEPS.

8) EVEN THOUGH THE CONGRESS ESTABLISHED THE MANDATE THAT ALL NEW BUILDINGS SHALL COMPLY WITH THE STANDARDS, WE BELIEVE THAT AN INITIALLY VOLUNTARY COMPLIANCE EFFORT IS ESSENTIAL TO THE SUCCESS OF THE BEPS PROGRAM.

ALTHOUGH A GREAT DEAL OF WORK HAS BEEN DONE IN PREPARATION FOR IMPLEMENTING A PERFORMANCE STANDARD, THERE ARE NUMEROUS INDICATIONS IN THE NOPR AND IN THE TEN TECHNICAL SUPPORT DOCUMENTS THAT CERTAIN RESEARCH ON CRITICAL ELEMENTS OF THE STANDARD IS INCOMPLETE AND ONGOING. THIS FACT HAS BEEN ADMITTED THROUGHOUT THE DISCUSSION AND PREAMBLE OF THE NOPR. WE INTERPRET THIS AS AN EXTREMELY SERIOUS ADMISSION THAT THE LEGISLATIVE MANDATE FOR DEVELOPING SUCH A STANDARD PRIOR TO AUGUST 14, 1980, WAS ILL-CONCEIVED. WE ARE MINDFUL THAT THE DEPARTMENT OF ENERGY MUST RESPOND TO THE BEST OF ITS ABILITY TO THE DEADLINES AND REQUIREMENTS ESTABLISHED BY THE CONGRESS. OUR COUNCIL BELIEVES THAT DOE HAS MADE A REMARKABLE ATTEMPT TO COMPLY WITH THE LAW, DESPITE THE INTENSELY TIME CONSUMING RESEARCH EFFORT, AND THE LACK OF ADEQUATE STAFF MEMBERS ASSIGNED TO THE BEPS PROGRAM. HOWEVER, THE TIME HAS COME TO RECOGNIZE SEVERAL VERY BASIC FACTS. FIRST, THE RESEARCH EFFORT IS AT THIS MOMENT INCOMPLETE. SECOND, VITAL INFORMATION WHICH MAY ALTER THE REQUIREMENTS OF THE STANDARD

WILL BE A PRODUCT OF THE UNFINISHED RESEARCH. THIRD, THE PUBLIC WILL NOT BE OFFERED ANOTHER OPPORTUNITY TO REACT TO SUCH INFORMATION PRIOR TO THE RELEASE OF THE FINAL STANDARD. FOURTH, THE FEDERAL ADMINISTRATIVE PROCEDURES ACT REQUIRES PUBLIC DISCLOSURE OF ALL INFORMATION NECESSARY TO INTERPRET AND RESPOND TO A PROPOSED FEDERAL RULE PRIOR TO SUCH RULE BECOMING FINAL.

THEREFORE, THE ONLY LOGICAL SUGGESTION WE CAN OFFER IS THAT DOE IMMEDIATELY SUBMIT A REQUEST TO CONGRESS THAT THE LEGISLATIVE DEADLINES IMPOSED BY TITLE III OF PUBLIC LAW 94-385, SECTION 304(A), BE ADJUSTED TO PERMIT COMPLETION OF THE RESEARCH EFFORT AND INCORPORATION OF THIS NEW INFORMATION INTO A REVISED NOTICE OF PROPOSED RULEMAKING AT SOME POINT IN THE FUTURE. SUCH A REQUEST NEED NOT BE CONSIDERED BY THE CONGRESS OR THE ADMINISTRATION AS A DOE FAILURE TO PRODUCE AN ENERGY STANDARD IN TIME, BUT MERELY A FAILURE OF THE ORIGINAL LEGISLATION TO RECOGNIZE THE INSURMOUNTABLE TASK THAT IS BEFORE US - TO CONTROL AND REDUCE ENERGY CONSUMPTION IN AN ORGANIZED AND CONSCIOUS WAY. AT THE OUTSET, WE RECOMMEND THAT DOE SUBMIT A FORMAL REQUEST TO THE CONGRESS TO HAVE THE STATUTORY IMPLEMENTATION REQUIREMENTS RELAXED TO PERMIT THE DEVELOPMENT OF A USEFUL STANDARD AND TO AVOID POTENTIAL HARDSHIP WITHIN THE CONSTRUCTION INDUSTRY.

AS EVIDENCE TO SUPPORT OUR RECOMMENDATION, WE SUBMIT THE FOLLOWING DETAILED REGULATORY ANALYSIS CONDUCTED BY OUR NATIONAL ENERGY COMMITTEE AND OUR STAFF. WE BEGIN WITH A SECTION BY SECTION ASSESSMENT OF THE NOTICE OF PROPOSED RULEMAKING AS IT APPEARED IN THE

WEDNESDAY, NOVEMBER 28, 1979, FEDERAL REGISTER.

SUBPART A - PERFORMANCE STANDARDS:

ACEC HAS NO OBJECTION TO THE PURPOSE AND SCOPE OF THE PROPOSED STANDARDS AS PRESENTED IN SECTION 435.01. WE CONCUR THAT FEDERAL POLICIES AND PRACTICES BE REDIRECTED TO ENCOURAGE THE INCORPORATION OF ENERGY CONSERVATION FEATURES IN NEW BUILDING DESIGNS.

HOWEVER, WE ARE GRAVELY CONCERNED THAT DOE HAS MISINTERPRETED THE TASK ESTABLISHED BY CONGRESS WITH REGARD TO ENERGY EFFICIENCY AND FUEL USAGE. WHILE WE RECOGNIZE THE NEED TO ENCOURAGE THE USE OF NONDEPLETABLE SOURCES OF ENERGY, WE BELIEVE THE PROPOSED STANDARD DISCRIMINATES AGAINST CERTAIN ELECTRIC GENERATING PROCESSES BASED UPON NONDEPLETABLE ENERGY SOURCES. OUR COUNCIL STRONGLY RECOMMENDS REASSESSMENT OF BOTH THE CONGRESSIONAL MANDATE FOR PROMULGATING BEPS AND THE SEVERE HARDSHIPS WHICH WILL BE IMPOSED ON NUCLEAR, HYDROELECTRIC, AND COAL-FIRED ELECTRIC GENERATING FACILITIES THROUGH APPLICATION OF THE SO-CALLED "WEIGHTING FACTORS". IT WOULD APPEAR THAT IN THE PROCESS OF DEVELOPING A PERFORMANCE STANDARD FOR NEW BUILDING DESIGNS, DOE HAS ALSO ESTABLISHED A NATIONAL FUEL USE POLICY WHICH SEEMS TO CONFLICT WITH ENERGY POLICIES PROMOTED BY THE CARTER ADMINISTRATION.

WE SUPPORT DOE'S EFFORTS TO ENCOURAGE STATES AND LOCAL GOVERNMENTS TO ADOPT AND ENFORCE STANDARDS SUCH AS THESE THROUGH THEIR EXISTING BUILDING CODE AND CONSTRUCTION PERMIT-GRANTING AUTHORITIES. HOWEVER, WE MUST POINT OUT THAT THE MAJORITY OF ALL STATES HAVE, IN THE ABSENCE OF A FEDERAL STANDARD, UNDERTAKEN ON THEIR OWN TO DEVELOP AND ADOPT STANDARDS FOR REDUCING ENERGY CONSUMPTION IN NEW BUILDINGS. THE 45 STATES THAT HAVE ADOPTED ENERGY STANDARDS SINCE THE 1974 ARAB OIL EMBARGO ARE EVIDENCE OF THIS FACT. THEREFORE, IT WOULD STAND TO REASON THAT DOE SHOULD FOCUS ITS EFFORTS ON THE REMAINING STATES WITH NO EXISTING ENERGY CONTROL STANDARDS AND TAKE LESSONS FROM THE PROCESSES EMPLOYED BY THE 45 STATES WHO ARE LEADING THE WAY IN DEALING WITH ENERGY CONSCIOUS DESIGN.

ACEC TAKES NO ISSUE WITH THE "DEFINITIONS" OUTLINED IN SECTION 435.02 FOR BRITISH THERMAL UNITES, BUILDING CODES, BUILDING DESIGN, COMMERCIAL BUILDING, DESIGN ENERGY BUDGET, FEDERAL AGENCY, FEDERAL BUILDING, FUNCTION, NEW BUILDING, RESIDENTIAL BUILDING, OR STANDARD METROPOLITAN STATISTICAL AREA. HOWEVER, WE ARE CONCERNED WITH THE DEFINITIONS OFFERED FOR DESIGN ENERGY CONSUMPTION, GROSS AREA, AND STANDARD EVALUATION TECHNIQUE. OUR CONCERNS STEM FROM A LACK OF CONFIDENCE IN CALCULATING ANNUAL ENERGY CONSUMPTION, EXPRESSED AS MBTUS/SQ.FT./YR. BASED UPON THE GROSS AREA OF A BUILDING DESIGN. ANY ENGINEER WILL TELL YOU THAT SERIOUS INEQUITIES BECOME APPARENT WHEN ATTEMPTING TO CALCULATE ENERGY CONSUMPTION WITHOUT DUE CONSIDERATION TO THE SPECIAL CHARACTERISTICS OF THERMAL MASS (INCLUDING STRUCTURE) AND THE BUILDING'S VOLUME. THE STANDARD EVALUATION TECHNIQUE IGNORES BENEFITS ACHIEVED BY LOW NET/GROSS RATIOS INVOLVING HIGH PERCENTAGES OF STRUCTURAL MASS WITH HEAT RETENTION POTENTIAL. IT ALSO EXEMPTS BASEMENTS AND CRAWL SPACES FOR WHAT DOE HAS TERMED AS AN "INADEQUATE INFORMATION BASE" FOR BELOW GRADE

THERMAL CHARACTERISTICS. THE COUNCIL RECOMMENDS MORE DETAILED WORK IN THESE TWO AREAS PRIOR TO PROMULGATING A FINAL STANDARD. WE ARE ALSO VERY SENSITIVE TO THE LACK OF CREDIT OR PENALTY PROPOSED FOR INFILTRATION RATES BELOW .6 AIR CHANGES/HR. HOWEVER, WE WILL REFRAIN FROM OFFERING ANY TECHNICAL COMMENT ON THIS ISSUE UNTIL THE RESEARCH UNDERWAY AT DOE'S DIRECTION IS COMPLETE.

ACEC IS SERIOUSLY CONCERNED WITH POTENTIAL INTERPRETATIONS UNDER SECTION 435.03, REQUIREMENTS FOR THE PERFORMANCE STANDARDS. ALTHOUGH NUMEROUS STATEMENTS ARE MADE TO EMPHASIZE THAT BEPS IS A "DESIGN" STANDARD WITH NO BEARING ON ACTUAL PERFORMANCE AFTER THE BUILDING IS CONSTRUCTED, WE CONTEND THAT BUILDING OWNERS AND BUILDING MANAGERS WILL COMPARE THE DESIGN ENERGY CONSUMPTION WITH THE ACTUAL ENERGY CONSUMPTION AS SOON AS A DATA BASE FOR THE ACTUAL CONSUMPTION IN THE BUILDING CAN BE DEVELOPED. DESPITE THE DOE STATEMENT THAT NO LIABILITY IS FORSEEN FOR ENGINEERS AND ARCHITECTS WHEN THE BUILDING FAILS TO MEET THE ENERGY BUDGET IN ACTUAL OPERATION, THE RESPONSIBILITY FOR SUCH FAILURE WILL BE LITIGATED AND DECIDED IN COURTS OF LAW ACROSS THE COUNTRY. SUCH LEGAL DISPUTES ARE ENORMOUSLY EXPENSIVE. DOE SHOULD DEVELOP SPECIFIC LANGUAGE AS PARAGRAPH (E) OF SECTION 435.03 TO ADDRESS THIS UNCERTAINTY AND TO "HOLD HARMLESS" ENGINEERS AND ARCHITECTS WHO DESIGN BUILDINGS IN ACCORDANCE WITH THE STANDARDS, BUT WHOSE BUILDINGS FAIL TO MEET THE DESIGNED CONSUMPTION LEVELS WHEN THE BUILDING IS OPERATED OUTSIDE OF LIMITS IMPOSED BY THE STANDARD BUILDING OPERATING CONDITIONS, OR WHEN CLIMATE VARIABLES RESULT IN CONSUMPTION FIGURES BEYOND THOSE CONSIDERED DURING THE DESIGN PROCESS. SUCH A NEW PARAGRAPH SHOULD READ:

(E) THE DESIGN ENERGY CONSUMPTION OF THE NEW BUILDING DESIGN SHALL NOT BE BINDING ON ACTUAL ENERGY CONSUMPTION LEVELS DUE TO VARIATIONS IN (1) BUILDING OPERATING CONDITIONS (2) ABNORMAL CLIMATE CHARACTERISTICS (3) CHANGES IN BUILDING FUNCTION OR USE.

ACEC IS AWARE THAT BUILDING DESIGN AND FUNCTION CLASSIFICATIONS UNDER SECTION 435.04 ARE INTENTIONALLY REDUCED TO A SIMPLE DESCRIPTION OF BUILDING TYPE AND USE. THE 22 CLASSIFICATIONS WHICH APPEAR IN THE PROPOSED RULE REPRESENT A GOOD FIRST ATTEMPT TO ORGANIZE INFORMATION SO AS TO MANAGE THE EXTREME DIVERSITIES OF ENERGY DEMAND ON BUILDINGS OF DIFFERING FUNCTION. WE CANNOT CRITICIZE THIS INITIAL EFFORT. HOWEVER, WE ARE MINDFUL THAT MANY BUILDINGS WILL FALL INTO THE "OTHER" CATEGORY DUE TO THEIR MULTI-USE CHARACTERISTICS AND THE RIGIDITY OF THE PERCENTAGE FIGURES WHICH ARE ESTABLISHED IN THE OTHER 21 CATEGORIES. IT WOULD NOT SURPRISE US TO FIND MANY NEW BUILDING OWNERS SEEKING SOME TYPE OF EXEMPTION TO THE STANDARDS CLAIMING THAT THEY ARE NOT COVERED BY CATEGORIES DOE HAS ESTABLISHED.

THE SELECTION OF AN APPLICABLE CLIMATE OUTLINED IN SECTION 435.05 IS, IN OUR OPINION, ADEQUATE FOR ESTIMATING DESIGN ENERGY CONSUMPTION. WE CAUTION DOE THAT THE CLIMATE TABLES FOR STANDARD METROPOLITAN STATISTICAL AREAS (SMSAS) ARE DERIVED FROM INFORMATION GENERATED BY THE NATIONAL WEATHER SERVICE AND THE FEDERAL AVIATION ADMINISTRATION. THE INFORMATION COLLECTED BY THESE TWO AGENCIES WAS ORIGINALLY INTENDED FOR AGRICULTURAL AND AIR TRANSPORT PURPOSES.

MICRO-CLIMATE WEATHER INFORMATION APPLICABLE TO BUILDING ENERGY CONSUMPTION DOES NOT EXIST WITH ANY DEGREE OF ACCURACY. THEREFORE, FIGURES WHICH RESULT FROM EITHER COMPUTER ANALYSIS OR MANUAL CALCULATIONS, UTILIZING CLIMATE DATA FROM APPENDIX I, WILL RESULT IN ESTIMATES OF A BUILDING'S ENERGY CONSUMPTION. ACCURACY WILL IMPROVE AS DESIGNERS BECOME FAMILIAR WITH THE STANDARDS AND A BETTER DATA BASE DEVELOPS FOR SPECIFIC SITING AND CLIMATE CONDITIONS.

UNDER SECTION 435.06 - PROCEDURES FOR ESTABLISHING ALTERNATE EVALUATION TECHNIQUES, ACEC SUPPORTS DOE'S RECOGNITION OF MANUAL CALCULATION METHODS. OUR ORGANIZATION IS COMPOSED OF 3,600 CONSULTING FIRMS THROUGHOUT THE UNITED STATES. 62.9% OF THESE FIRMS EMPLOY 10 OR FEWER INDIVIDUALS. THE BURDEN OF COSTLY COMPUTER TIME AND REPEATED COMPUTER ITTERATIONS IS EXTREME ON SUCH SMALL DESIGN FIRMS. WITHOUT QUESTION, THE FAVORITISM EVIDENT IN THE PROPOSED RULE FOR COMPUTER EVALUATIONS WILL DISCRIMINATE AGAINST THE SMALL DESIGN FIRM WHICH HAS NOT HISTORICALLY DEALT WITH SUCH SOPHISTICATED EQUIPMENT. THE LARGER FIRMS, ON THE OTHER HAND, ARE PREPARED TO BEGIN USING THE STANDARDS AND WILL NOT BE SUBJECT TO THE ENORMOUS LEARNING CURVES THAT SMALL FIRMS WILL CONFRONT. DOE SHOULD MAKE EVERY EFFORT TO RECOGNIZE SIMPLIFIED MANUAL CALCULATION TECHNIQUES AND TO UNDERSTAND THAT THE COMPUTER IS NOT A "DESIGN TOOL" AS IS SO OFTEN ASSUMED. THE MOST EFFICIENT APPLICATION OF A COMPUTER OCCURS AFTER THE BUILDING HAS BEEN DESIGNED BECAUSE MUCH OF THE COMPUTER INPUT MATERIAL IS DEPENDENT UPON DECISIONS MADE DURING THE SCHEMATIC DESIGN, DESIGN DEVELOPMENT, AND CONSTRUCTION DOCUMENTS PHASES OF THE DESIGN PRO-

CESS. IN OTHER WORDS, IT IS A FACT THAT THE COMPUTER SERVES ONLY TO VERIFY THAT CERTAIN DECISIONS WITH REGARD TO DESIGN AND CERTAIN COMBINATIONS OF MATERIALS AND EQUIPMENT ARE INDEED CORRECT. AT THE POINT OF COMPUTER ANALYSIS, MOST DESIGN DECISIONS HAVE ALREADY BEEN MADE. IF THE COMPUTER EVALUATION INDICATES THAT AN IMPROPER DECISION WAS MADE, THE ACT OF CORRECTING THAT DECISION MAY HAVE A SIGNIFICANT IMPACT ON OTHER DECISIONS WHICH HAVE BEEN MADE DURING THE DESIGN PROCESS. ALTERING ONE DECISION TO SATISFY THE COMPUTER EVALUATION MAY REQUIRE AS MUCH ADDITIONAL DESIGN TIME AS WAS REQUIRED FOR THE ORIGINAL SET OF DESIGN DECISIONS. THIS IS COSTLY TO THE FIRM AND, ULTIMATELY, TO THE CLIENT WHO MUST PAY FOR THE COMPUTER ANALYSIS AND ANY ADDITIONAL TIME REQUIRED TO ALTER THE ORIGINAL DESIGN.

IT IS UNREALISTIC TO ASSUME THAT NO ADDITIONAL COSTS WILL RESULT FROM DESIGNERS HAVING TO ADOPT AND USE THE BEPS. IT IS JUST SUCH A STATEMENT THAT CAUSES US TO SERIOUSLY QUESTION THE ACCURACY AND THE RELIABILITY OF THE ECONOMIC ANALYSIS CONDUCTED BY THE BATTELLE CORPORATION UNDER CONTRACT TO DOE. THE ESTIMATES OF INCREASES OF FROM 3-5% IN COMMERCIAL FACILITY COSTS AND OF $1.00/SQ.FT. IN RESIDENTIAL PROJECT COSTS ARE SIMPLY ERRONEOUS AND BEYOND BELIEF. THE DEPARTMENT OF ENERGY HAS SPECULATED THAT, OF NECESSITY DESIGN COSTS AND ARCHITECTURAL AND ENGINEERING FEES WILL INCREASE. YET, NO SPECIFIC COST PROJECTIONS ARE PROVIDED. WE AGREE WITH DOE AND WE OFFER ESTIMATES OF INCREASES RANGING FROM 10% - 40% OVER USUAL DESIGN FEES. OUR FIGURES ARE DERIVED FROM INFORMATION MADE AVAILABLE FROM CONSULTING ENGINEERS THROUGHOUT THE COUNTRY, MOST OF WHOM

WILL BE REQUIRED TO ENGAGE AN ADDITIONAL CONSULTANT TO UNDERTAKE THE COMPUTER SIMULATIONS REQUIRED BY THE BEPS.

UNDER SECTION 435.06, WE ARE CONCERNED WITH THE MANY STATEMENTS THAT "DOE SHALL DETERMINE WHETHER PROCEDURES SUBMITTED ARE ACCEPTABLE AS AN ALTERNATE EVALUATION TECHNIQUE." OUR COUNCIL UNDERSTANDS THAT DOE OPERATES WITH ONLY SIX (6) PROFESSIONAL STAFF MEMBERS IN THE BUILDINGS DIVISION WITHIN THE OFFICE OF BUILDINGS AND COMMUNITY SYSTEMS. WITH SUCH LIMITATIONS ON STAFF RESOURCES, IT IS BEYOND OUR IMAGINATION TO ENVISION A SUCCESSFUL DOE EFFORT TO ANALYZE AND APPROVE ALTERNATIVE EVALUATION TECHNIQUES. WE STRONGLY RECOMMEND THAT THE SECRETARY REASSESS DOE PROGRAM NEEDS AND REINFORCE THE BUILDINGS DIVISION. IN THE ABSENCE OF ADEQUATE SUPPORT STAFF, A BOTTLENECK WILL OCCUR CAUSING ENORMOUS DELAYS AND UNNECESSARY HARDSHIPS.

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ACEC ACKNOWLEDGES THE FACT THAT SUBPART B IS RESERVED FOR THE FORTHCOMING PROPOSED IMPLEMENTATION REQULATIONS. HOWEVER, OUR COUNCIL HAS NUMEROUS CONCERNS WITH REGARD TO ANY PROPOSED IMPLEMENTATION PLAN FOR A NATIONAL DESIGN STANDARD. WE WOULD LIKE TO SUBMIT OUR CONCERNS RELATIVE TO IMPLEMENTATION LATER IN OUR STATEMENT.

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WE WILL NOT COMMENT ON SUBPART C - ADMINISTRATIVE REVIEW - OTHER THAN TO PROPOSE THAT AN ONGOING SYSTEM OF MONITORING THE ENERGY BUDGET LEVELS AND UPDATING THE PROCEDURES BE DEVELOPED. IT IS OUR OPINION THAT A BI-ANNUAL REVIEW OF A SPECIFIC SAMPLE OF NEW BUILDING DESIGNS SHOULD BE UNDERTAKEN TO DETERMINE IF COMPLIANCE IS BEING ACHIEVED. THIS COULD BE CONSIDERED A RANDOM SAMPLE - WITHIN EACH OF THE DEFINED BUILDING CATEGORIES, AND WOULD RESEMBLE THE SPOT CHECK PROCESS UTILIZED BY THE INTERNAL REVENUE SERVICE.

THE FOREGOING COMMENTS ARE OFFERED IN RESPONSE TO THE SPECIFIC SECTIONS OF THIS RATHER BRIEF PROPOSED RULE. THERE ARE ADDITIONAL COMMENTS WE WOULD LIKE TO PRESENT AT THIS TIME THAT WE BELIEVE ARE RELEVANT TO THE FINAL RULEMAKING. WITH YOUR PERMISSION WE SUBMIT THESE COMMENTS FOR YOUR CONSIDERATION AND WE OFFER OUR ASSISTANCE TOWARD THE RESOLUTION OF THE MANY PROBLEMS RAISED BY THE INITIAL RESEARCH AND BY THE PROPOSED RULE.

- THE STANDARD EVALUATION TECHNIQUE CONTAINS CERTAIN INPUT PARAMETERS WHICH APPEAR TO BE FIXED - SUCH AS THE INFILTRATION FACTOR OF .6 AIR CHANGES/HR., THE WEATHER DATA, AND THE STANDARD BUILDING OPERATING CONDITIONS. OUR CONCERN IS THAT SUCH INFORMATION SHOULD NOT BE FIXED AS THERE WILL BE INSTANCES WHERE FLEXIBILITY AND INTERPRETATION OF THESE PARAMETERS WILL PRODUCE MORE VALID RESULTS, I.E., A MORE ACCURATE ESTIMATE OF THE ACTUAL BUILDING ENERGY CONSUMPTION.

- THE DOE II COMPUTER PROGRAM PRESENTLY NEGLECTS BENEFITS ACHIEVED BY DAYLIGHTING, SOLAR HEATING (ACTIVE AND PASSIVE), DEAD BAND, AND USE PROFILES. DOE HAS CATEGORIZED SUCH ELEMENTS AS "CREDITABLE" TOWARD THE TOTAL ENERGY BUDGET AND THEREFORE NOT CONSIDERED IMPORTANT TOWARD AN ACCURATE CALCULATION OF TOTAL ENERGY CONSUMPTION. WE DISAGREE WITH THIS APPROACH AND WE RECOMMEND THAT STEPS BE TAKEN TO INCLUDE THE ABOVE ELEMENTS AS WELL AS INFORMATION ON THERMAL CHARACTERISTICS OF THE BUILDING STRUCTURE (MASS) IN THE FINAL RULE. IF OUR TASK IS TO UNDERSTAND HOW ENERGY IS USED IN BUILDINGS, WE MUST NOT IGNORE SETS OF DATA THAT WILL BRING US CLOSER TO THIS UNDERSTANDING.

- AS WE STATED EARLIER, WE ARE EXTREMELY SKEPTICAL OF THE STATISTICAL BASE FROM WHICH THE ENERGY BUDGETS WERE DERIVED. THE ORIGINAL 1,661 BUILDINGS SURVEYED UNDER PHASE I WAS, IN OUR OPINION, A VERY GOOD SAMPLE. HOWEVER, THE PHASE II RESEARCH AND THE PHASE II REDESIGNS WERE CONDUCTED ON A MUCH SMALLER SAMPLE OF 168 BUILDINGS. WE UNDERSTAND THAT THE LACK OF ADEQUATE FUNDS PREVENTED STUDY OF THE ENTIRE PHASE I SAMPLE. YET, WE BELIEVE IT TO BE IMPRUDENT TO ATTEMPT TO BASE A NATIONAL ENERGY STANDARD ON SO LIMITED A RESEARCH STUDY. IF NOT FOR THE DEADLINES IMPOSED BY CONGRESS, WE WOULD SERIOUSLY RECOMMEND THAT DOE DEFER ACTION ON

THE RULEMAKING AND EXPAND THE PHASE II RESEARCH DATA BASE.

- DURING THE PHASE II ANALYSIS, A REGRESSION TECHNIQUE WAS USED TO TEST THE VARIABLES WHICH SEEMED TO INFLUENCE A BUILDING'S ENERGY CONSUMPTION CHARACTERISICS. IN ORDER TO USE THE INFORMATION RESULTING FROM THE REGRESSION ANALYSIS, ESTIMATES WERE MADE TO DETERMINE THE AVERAGE USE OF CERTAIN CHARACTERISTICS FOR EACH BUILDING TYPE. THIS ESTIMATION TECHNIQUE COMPROMISES THE ORIGINAL FINDINGS AND SERIOUSLY DILUTES CASES OF WIDE VARIATION FROM WHAT IS CONSIDERED THE NORM. IT IS OUR OPINION THAT THESE AVERAGES DO NOT REPRESENT THE "REAL WORLD" SITUATION. IT WOULD BE EXTREMELY VALUABLE TO LEARN OF THE BOUNDARY CONDITIONS REVEALED BY THE REGRESSION ANALYSIS TO DETERMINE HOW WIDE THE VARIATIONS ARE FOR EACH BUILDING TYPE.

- ACEC IS ALSO CONCERNED WITH THE NON-RESPONSE, APPROACHING NEARLY 50 PERCENT OF THE SELECTED SAMPLE, DURING THE PHASE I SURVEY. WHILE IT IS DIFFICULT TO ASSUME THAT THE INFORMATION OVERLOOKED, AS THE RESULT OF THE POOR RESPONSE, WOULD HAVE SIGNIFICANTLY ALTERED THE TECHNIQUES EMPLOYED DURING THE STATISTICAL ANALYSIS, IT IS PROBABLE THAT SUCH INFORMATION WOULD HAVE IMPACTED THE RESULTING ENERGY BUDGET LEVELS. IN OTHER WORDS, WE ARE NOT CONFIDENT IN THE LEAST THAT THE RE-

SULTS PRESENTED BY THE STRENUOUS RESEARCH EFFORT REFLECT THE PROPER PROFILE OF ENERGY USAGE IN OUR NATION'S BUILDINGS. THE SAMPLE SIZE WAS SEVERELY NARROW. WE COULD BE MORE POSITIVE ABOUT THE RESEARCH FINDINGS IF A BROADER SAMPLE WERE STUDIED AND AN ASSESSMENT MADE TO IDENTIFY THE ACCURACY OF THE METHODOLOGY EMPLOYED.

- WE HAVE STRONG NEGATIVE REACTIONS TO THE DRAFT REGULATORY ANALYSIS PUBLISHED IN NOVEMBER OF 1979. IT APPEARS THAT NO ANALYSIS WAS CONDUCTED OF THE LIKELY IMPACTS OF THE STANDARDS ON STATE AND LOCAL BUILDING CODE AUTHORITIES. THE DRAFT REGULATORY ANALYSIS, AS PUBLISHED, IS RHETORICAL AND NEGLECTS MANY OF THE POTENTIAL IMPACTS OF THE STANDARDS ON THE CONSTRUCTION INDUSTRY. WE RECOGNIZE THE GENERALITIES WHICH APPEAR CONCERNING REAL ESTATE VALUES, CONSTRUCTION MATERIALS, LABOR AND ENFORCEMENT. HOWEVER, THE TOTAL ASSESSMENT OF THE IMPACT OF THE BEPS ON THE ENTIRE CONSTRUCTION INDUSTRY IS THREE PAGES LONG AND CONTAINS 45 SENTENCES. THE INFORMATION MADE AVAILABLE IN THOSE 45 SENTENCES IS OF QUESTIONABLE VALUE DUE TO THE FACT THAT ONLY CONCLUSIONS ARE STATED RELATIVE TO SOMEONE'S PROJECTION OF FUTURE MARKET SHIFTS AND MATERIAL SUPPLY TRENDS. IT WOULD BE USEFUL TO KNOW IF THE ASSESSMENT OF POTENTIAL IM-

PACTS ON THE CONSTRUCTION INDUSTRY WAS CONDUCTED USING CENSUS BUREAU STATISTICS, LABOR DEPARTMENT STATISTICS, INTERNAL REVENUE STATISTICS OR BASED UPON SOME SAMPLE NUMBER OF INSULATION SUPPLIERS, WINDOW MANUFACTURERS AND ELECTRICIANS.

- THE ONE NOTEWORTH ELEMENT IN THE REGULATORY ANALYSIS IS THE ASSUMPTION THAT EFFECTIVE IMPLEMENTATION OF THE BEPS WILL NOT BE ACHIEVED UNTIL 1985. WE AGREE WITH THIS ASSUMPTION AND WE ANTICIPATE AT LEAST FIVE YEARS OF PHASED IMPLEMENTATION FOLLOWING THE FINAL RELEASE OF THE STANDARDS.

- THE REGULATORY ANALYSIS FOCUSES ON THE IMPACT OF THE BEPS ON THE NATION AND NATIONAL ECONOMY. WE WOULD HAVE PREFERRED TO LEARN OF THE STANDARDS POTENTIAL IMPACT ON 1) DESIGN FIRMS, 2) LOCAL CONSTRUCTION PERMIT OFFICES, 3) CONSTRUCTION CONTRACTORS WHO MUST REVIEW THE PLANS FOR QUANTITY TAKE-OFFS, 4) LOCAL MATERIAL SUPPLIERS WHO MUST RESPOND TO ORDERS PLACED BY GENERAL CONTRACTORS AND SUB-CONTRACTORS, 5) LOCALIZED LABOR SUPPLY PROBLEMS, 6) INSPECTION SERVICES REQUIRED FOR SPECIFIC REGIONS AND/OR BUILDING TYPES, 7) MANUFACTURERS WHO MUST CREATE NEW PRODUCTS FOR THE NEW DUTIES.

- THE DRAFT ENVIRONMENTAL IMPACT STATEMENT IDENTIFIES THE PROBLEM OF INDOOR AIR QUALITY QUITE CLEARLY. CONSULTING ENGINEERS ARE PARTICULARLY SENSITIVE TO THIS ISSUE AS IN MOST CASES THEY ARE RESPONSIBLE FOR THE DESIGN OF AIR HANDLING SYSTEMS TO SATISFY LOCAL CODES AND SPECIALIZED BUILDING FUNCTIONS. ACEC IS COGNIZANT OF THE FACT THAT RESEARCH IS UNDERWAY TO DETERMINE IF .6 AIR CHANGES/HR. IS HARMFUL TO INHABITANTS OF THE TYPICAL HOME. WE BELIEVE THAT THE RESULT OF SUCH RESEARCH WILL BE INCONCLUSIVE DUE, PRIMARILY, TO THE FACT THAT INFILTRATION RATES AND CHANGES IN INDOOR PRESSURE ARE EXTREMELY DIFFICULT TO CONTROL WITH ANY ACCURACY. THE RESEARCH WILL SHOW THAT ATMOSPHERIC PRESSURE, WIND VELOCITY, RELATIVE HUMIDITY, AND OTHER SPECIFIC SITING CHARACTERISTICS ARE ALL FACTORS IN ATTEMPTING TO COMPUTE THE INFILTRATION RATE FOR A SPECIFIC BUILDING. THEREFORE, IT IS NOT FEASIBLE TO SET A FIXED VALUE FOR INFILTRATION AND EXPECT IT TO BE MET IN ACTUAL PRACTICE.

- THE ENVIRONMENTAL IMPACT STATEMENT APPEARS TO OVERLAP INTO AREAS OF ECONOMIC RATHER THAN ENVIRONMENTAL CONCERN. THE TWO SCENARIOS OFFERED IN SECTION 2 OF THE EIS ARE REALLY BEYOND THE SCOPE OF AN ENVIRONMENTAL ASSESSMENT. THESE SCENARIOS ARE BASED UPON ASSUMPTIONS THAT A - FUEL PRICES CONTINUE TO RISE AT A RATE APPROXIMATELY EQUAL TO

THE RATE IN 1978 AND 1979, AND B - THAT FUEL PRICES WILL INCREASE AT AN ACCELERATED RATE. THIS TYPE OF INFORMATION BELONGS IN THE ECONOMIC IMPACT ASSESSMENT AND IT IS CONFUSING TO SEE IT REPEATED IN THE ENVIRONMENTAL IMPACT STATEMENT.

- ANOTHER CONFUSING POINT NEEDS TO BE RAISED CONCERNING THE CLAIM IN THE ENVIRONMENTAL IMPACT STATEMENT (PAGE 3) THAT "IT IS ANTICIPATED THAT THE STANDARDS WILL CAUSE A RISE IN CONSTRUCTION COSTS OF APPROXIMATELY 1% FOR COMMERCIAL BUILDINGS." THIS CONTRADICTS THE STATEMENTS MADE BOTH IN THE ECONOMIC ANALYSIS AND THE PREAMBLE TO THE PROPOSED RULE THAT CONSTRUCTION COSTS FOR NEW COMMERCIAL FACILITIES ARE EXPECTED TO INCREASE FROM 3-5%. SUCH CONTRADICTIONS SHOULD HAVE BEEN AVOIDED IN THE RELEASE OF THE TECHNICAL SUPPORT DOCUMENTS AS IT CAUSES THOSE OF US WHO HAVE STUDIED THE MATERIAL TO SEVERELY QUESTION ITS CREDIBILITY.

- DOE ADMITS ON PAGE 4-42 OF THE ENVIRONMENT IMPACT STATEMENT THAT "CODE VIOLATIONS RELATING TO VENTILATION WERE FOUND IN SOME OF THE PHASE 2 REDESIGNS." IT SHOULD THEREFORE FOLLOW THAT SINCE PHASE 2 DATA DICTATED, TO A LARGE DEGREE, THE ENERGY BUDGET LEVELS ESTABLISHED IN THE PROPOSED RULE, THAT THIS ENTIRE MATTER SHOULD BE RE-ANALYZED WITH GREATER CONSISTENCY.

- IT IS DISCONCERTING THAT THE ENVIRONMENTAL IMPACT STATEMENT ANALYZES AIR POLLUTANTS ON A NATIONAL BASIS ONLY (REFER CHAPTER 4). APPARENTLY NO ANALYSIS WAS MADE ON A REGIONAL OR SITE-SPECIFIC BASIS UTILIZING THE FUEL MIX CHARACTERISTICS IMPOSED BY THE WEIGHTING FACTORS. THIS IS OF CRITICAL IMPORTANCE, PARTICULARLY IF THE WEIGHTING FACTORS WILL BE ALTERED TO REFLECT REGIONALIZED FUEL CONSUMPTION AND DEMAND. THE QUALITY OF COMBUSTION, THE METHOD OF MONITORING SUCH COMBUSTION AND CONTROLLING POLLUTANTS AT THE BUILDING SITE, AND THE PRACTICALITY OF COMPARING ON-SITE POLLUTANTS TO SITE-ELECTRIC GENERATING POLLUTANTS ARE MAJOR SHORTCOMINGS OF THIS REPORT.

- THE ECONOMIC IMPACT ANALYSIS PRESENTS US WITH A THOROUGH AND SEEMINGLY WELL EXECUTED ASSESSMENT OF THE OVERALL NATIONAL ECONOMIC IMPACTS. THE CONCLUSIONS REACHED, ON A NATIONAL SCALE, ARE GENERALLY POSITIVE AND FAVORED OVER ADVERSE IMPACTS WHICH MAY OCCUR WITHIN CERTAIN SEGMENTS OF THE BUILDING INDUSTRY. OUR READING OF THE ECONOMIC SUMMARY REVEALS A SERIOUS LACK OF CONCERN FOR THE SMALLER SCALE, LOCALIZED (OR REGIONALIZED) IMPACTS ON MATERIAL SUPPLIES, EMPLOYMENT, CONSTRUCTION PROCESSES, AND A LOCALITY'S ECONOMIC BASE. SAMPLE STUDIES OF SPECIFIC METROPOLITAN CIRCUMSTANCES SHOULD HAVE BEEN CONDUCTED TO BETTER

DETERMINE THE DEGREE AND COST OF COMMUNITY-WIDE DISRUPTION RELATING TO EMPLOYMENT AND CONSTRUCTION ACTIVITY IN THOSE AREAS. IF SUCH STUDIES WERE CONDUCTED TO ARRIVE AT THE CONCLUSIONS IN THE ECONOMIC SUMMARY, WE FIND NO REFERENCE TO THEM IN THE ECONOMIC IMPACT STATEMENT.

- THE ANALYSIS OF ECONOMIC IMPACTS ON THE NATION WAS CONDUCTED BASED UPON PROJECTIONS OF AVERAGE FUEL PRICING FORECASTS WHICH TEND TO UNDERESTIMATE THE ENORMOUS RISE IN FUEL PRICES EXPERIENCED IN RECENT MONTHS. WE UNDERSTAND THAT DOE IS COMPLETING AN ANALYSIS OF MARGINAL COST PROJECTIONS AND WILL SOON BE PREPARED TO APPLY THE MARGINAL COST ASSUMPTIONS TO THE BEPS PROGRAM. INFORMATION RESULTING FROM THE USE OF MARGINAL RATHER THAN AVERAGE PRICE PROJECTIONS WILL BE MORE CREDIBLE. HOWEVER, IT REMAINS TO BE SEEN THAT IF BY USING SUCH INFORMATION THE IMPACT OF THE BEPS ON OUR BUILDINGS WILL BE WORTH THE EFFORT TO CONSERVE. IT STANDS TO REASON THAT THE APPLICATION OF HIGHER PRICE PROJECTIONS WILL EMPHASIZE THE NEED TO REDUCE CONSUMPTION IN OUR NATION'S BUILDINGS. BUT, ON THE OTHER HAND, FOR EVERY DOLLAR INVESTED TODAY IN CONSERVATION INITIATIVES, THE RATE OF RETURN IN ACTUAL ENERGY SAVINGS IS SUBSTANTIALLY REDUCED. IN ANY EVENT, IT IS PREMATURE FOR THIS RULEMAKING TO

PROCEED IN THE ABSENCE OF A WELL-CONCEIVED ECONOMIC ASSESSMENT UTILIZING THE CORRECT COST ASSUMPTIONS, AND THE BEST AVAILABLE DATA FROM LOCALIZED SOURCES.

- ACEC IS FEARFUL THAT THE ECONOMIC ANALYSIS HAS SEGREGRATED OUT SOME ADVERSE IMPACTS AND COMPARED THEM INDIVIDUALLY TO THE CONCLUSION OF POSITIVE IMPACT ON THE NATION. TAKEN IN COMBINATION, THE TOTAL NEGATIVE IMPACT OF ALL ADVERSE CHARACTERISTICS MAY FAR EXCEED THE POSITIVE VALUE TO THE NATION OF THE PROPOSED STANDARDS. THE PREDICTION OF COMPETITIVE SHIFTS WITHIN THE BUILDING INDUSTRY, INCLUDING EXPECTATIONS OF NEW EMPLOYMENT OPPORTUNITIES FOR CONSTRUCTION LABORERS, MAY BE ENTIRELY OFFSET BY DECLINES IN EMPLOYMENT AND CAPITAL INVESTMENT IN THE UTILITY SECTOR. FURTHER REDUCTIONS IN AVAILABLE REVENUE, REDUCED LEVERAGE FOR OWNERS INTENDING TO BUILD, HIGHER INTEREST RATES, AND REDUCTIONS IN PRODUCTION AMONG MATERIAL MANUFACTURERS AND SLOWDOWN IN BUILDING PACE (P.2.12) MAY ALTER THE CONCLUSION THAT THE STANDARS WILL HAVE A NET POSITIVE IMPACT. WE HAVE SEEN NO COLLECTIVE ASSESSMENT OF ALL ADVERSE IMPACTS BALANCED AGAINST ALL POSITIVE IMPACTS. OUR CONCLUSION IS THAT FURTHER STUDY IS NEEDED TO VERIFY THAT POSITIVE IMPACTS WILL DOMINATE THE NEGATIVE FACTORS.

- ALTHOUGH OF LESSER CONCERN TO THE CONSULTING ENGINEERS WHO WILL BE REQUIRED TO DESIGN IN ACCORDANCE WITH THE STANDARDS, WE ARE SENSITIVE TO THE FACT THAT HOME BUYERS, PARTICULARLY THOSE WITH ALREADY DIFFICULT FINANCIAL STATUS, MAY BE PRICED OUT OF OWNING A NEW HOME RESULTING FROM EVEN THE SLIGHTEST INCREASE IN NEW HOUSING COSTS. IT IS UNCLEAR IN THE ECONOMIC ANALYSIS THAT THIS HAS BEEN CAREFULLY STUDIED. WE SUSPECT THAT THE HOMEBUYER WHO CAN BARELY AFFORD THE COST OF STANDARD HOUSING TODAY, WILL BE FORCED TO PURCHASE AN EXISTING, LESS EFFICIENT HOME AFTER BEPS GOES INTO EFFECT CAUSING A DECLINE IN DEMAND FOR NEW HOUSING AND, ULTIMATELY, A FURTHER SLOW-DOWN IN NEW HOUSING STARTS. THIS POINT SHOULD BE STUDIED CAREFULLY PRIOR TO ISSUING A FINAL RULE.

- THE REGULATORY ANALYSIS FAILS TO ADDRESS THE IMPACT OF BEPS ON EXISITING FEDERAL REGULATIONS GOVERNING FEE STRUCTURES FOR ENGINEERS AND ARCHITECTS. AS WE HAVE STATED, DESIGN FEES WILL INCREASE SUBSTANTIALLY FROM REQUIREMENTS TO SIMULATE THE DESIGN ENERGY PERFORMANCE OF A NEW DESIGN, EITHER THROUGH THE USE OF COMPUTERS OR APPROVED MANUAL CALCULATIONS. ALTHOUGH DOE ADMITS THAT DESIGN FEES ARE EXPECTED TO INCREASE, NO ANALYSIS WAS CONDUCTED TO DETERMINE THE IMPACT OF THIS INCREASE ON THE EXISTING STATUTORY FEE LIMITATION FOR ARCHITECTURAL AND ENGINEERING SERVICES PROCURED FOR FEDERAL DESIGN AND CONSTRUCTION CONTRACTS. IT APPEARS THAT

DOE IS LARGELY UNAWARE THAT SECTION 4(B), 10 USC 2306(D), (ARMED SERVICES PROCUREMENT ACT OF 1947), ESTABLISHED A GOVERNMENT-WIDE CEILING OF 6% OF TOTAL CONSTRUCTION COST AS THE MAXIMUM FEE TO BE PAID TO ARCHITECTS AND ENGINEERS PROVIDING DESIGN SERVICES TO THE GOVERNMENT. FURTHERMORE, ON DECEMBER 12, 1966, THE COMPTROLLER GENERAL OF THE UNITED STATES RULED THAT THE STATUATORY 6% LIMITATION PERMITTED NO COST EXCLUSIONS FOR NON-TRADITIONAL A-E SERVICES. THE COMPTROLLER GENERAL DECIDED THAT THE LIMITATION APPLIED TO AMOUNTS PAYABLE TO ARCHITECTS AND ENGINEERS FOR ANY SERVICE PERFORMED UNDER THE DESIGN PORTION OF THE CONTRACT. IN A SUBSEQUENT HOUSE REPORT (NO. 91-1445, 91ST CONG., 2ND SESS., SEPTEMBER 10, 1970, PAGE 12) THE GOVERNMENT OPERATIONS COMMITTEE CONCLUDED THAT THE SIX PERCENT LIMITATION APPLIES ONLY TO THE SUBMISSION OF DESIGNS, PLANS, DRAWINGS AND SPECIFICATIONS RELATING TO THE CONSTRUCTION OF A BUILDING OR OTHER FACILITY. AS A MATTER OF RECORD, THE HOUSE GOVERNMENT OPERATIONS COMMITTEE, AND THE COMPTROLLER GENERAL HAVE CONCLUDED THAT A/E "DESIGN" FEES, UNDER FEDERAL CONTRACTS, SHALL BE LIMITED TO 6% OF TOTAL CONSTRUCTION COST FOR "DESIGN" SERVICES.

THIS IS A VERY SERIOUS AND CRITICAL PROBLEM. DOE MUST TURN ITS ATTENTION IMMEDIATELY FROM PRONOUNCING THAT IT HAS DEVELOPED A "DESIGN STANDARD" TO INVESTIGATING THE ECONOMIC IMPACT OF SUCH A STANDARD ON THE EXISTING FEDERAL FEE LIMITATIONS. DESIGN PROFESSIONALS WILL SIMPLY REFUSE TO ACCEPT FEDERAL DESIGN CONTRACTS IF THE GOVERNMENT CONTINUES TO IMPOSE ADDITIONAL SERVICE REQUIREMENTS ON FIRMS UNDER THE SAME GOVERNMENT-WIDE 6% FEE LIMITATION. IF THE BEPS, AS PROPOSED, ARE TO BE EMBRACED WITH A POSITIVE ATTITUDE, DOE MUST ADVOCATE AND OBTAIN AN EXEMPTION FROM OR THE ABOLITION OF THE 6% FEE LIMITATION. THIS IS CLEARLY AN ISSUE WHICH SHOULD HAVE BEEN RESEARCHED DURING THE REGULATORY ANALYSIS.

OUR REMAINING REMARKS ARE PRESENTED IN THE FORM OF QUESTIONS AND ANSWERS. THIS IS DONE TO INDICATE OUR RESPONSE TO PROBLEMS WHICH EXIST BUT WHICH ARE NOT OBVIOUS. WE ASK THAT THESE QUESTIONS AND OUR PREPARED RESPONSES BE INCLUDED IN THE OFFICIAL HEARING RECORD.

Q. DOES THE ENERGY CONSERVATION POLICY ACT AUTHORIZE DOE TO CONSIDER "OFFSITE" CONSUMPTION OF ENERGY IN PROMULGATING BEPS?

A. THE AMERICAN CONSULTING ENGINEERS COUNCIL BELIEVES THAT THE ECPA DID NOT INTEND DOE TO CONSIDER "OFF-SITE" CONSUMPTION OF ENERGY. TITLE III OF PUBLIC LAW 94-385 IS SPECIFICALLY CITED AS THE "ENERGY CONSERVATION STANDARDS FOR NEW BUILDINGS ACT OF 1976." SECTION 302(A) OF TITLE III INDICATES THAT THE CONGRESS WAS PARTICULARLY CONCERNED WITH THE "LARGE AMOUNTS OF FUEL AND ENERGY CONSUMED UNNECESSARILY EACH YEAR IN HEATING, COOLING, VENTILATING, AND PROVIDING DOMESTIC HOT WATER FOR NEWLY CONSTRUCTED RESIDENTIAL AND COMMERCIAL BUILDINGS BECAUSE SUCH BUILDINGS LACK ADEQUATE CONSERVATION FEATURES." IT IS OUR INTERPRETATION OF THIS STATEMENT THAT THE LACK OF "ADEQUATE ENERGY CONSERVATION FEATURES" IN NEW BUILDINGS IS THE PRIMARY ISSUE REQUIRING DOE RESPONSE. ACEC CONTENDS THAT THE AUTHORITY GIVEN TO DOE WAS LIMITED TO THE "BUILDING LINE". CONCERN FOR "OFF-SITE" CONSUMPTION AND THE ESTABLISHMENT OF "WEIGHTING FACTORS" FOR VARIOUS FUEL TYPES IS CLEARLY OUTSIDE THE AUTHORITY FOR THE PROMULGATION OF THESE STANDARDS.

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Q. MAY DOE CONSIDER AND INCLUDE THE ENERGY CONSUMED IN THE ENERGY CONVERSION PROCESS?

A. OUR COUNCIL BELIEVES THAT DOE MAY AND SHOULD CONSIDER CONVERSION PROCESSES WHICH CONSUME LARGE AMOUNTS OF ENERGY, BUT

THE INCLUSION OF SUCH CONSIDERATIONS IN THE REGULATION IS IMPROPER AND BEYOND THE OBLIGATIONS ESTABLISHED BY THE ECPA.

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Q. MAY DOE CONSIDER AND INCLUDE THE ENERGY CONSUMED IN TRANSMITTING OR DELIVERING USEABLE ENERGY TO A BUILDING?

A. AGAIN, WE BELIEVE THAT SUCH INFORMATION IS USEFUL BUT IMPROPER FOR INCLUSION IN THE FINAL STANDARDS BECAUSE IT EXCEEDS THE RESPONSIBILITIES SET FORTH BY THE CONGRESS AND IT CREATES MONUMENTAL CONFLICTS WITH OTHER ONGOING DOE PROGRAMS.

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Q. DOES ECPA AUTHORIZE DOE TO DETERMINE THE "RELATIVE VALUE TO THE NATION OF CONSERVING DIFFERENT NONRENEWABLE FUELS?"

A. ACEC RECOGNIZES NO SUCH AUTHORITY, STATED OR IMPLIED, IN OUR READING OF THE LAW.

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Q. MAY DOE BASE THE STANDARDS ON SUCH A DETERMINATION?

A. IN OUR OPINION ... NO.

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Q. WHAT ARE THE ELEMENTS AND ASSUMPTIONS UNDERLYING DOE'S DETERMINATION OF "VALUE TO THE NATION"?

A. THE LEGISLATIVE HISTORY OF THE ECPA REVEALS THE CONGRESSIONAL INTENT TO CONSERVE FROM 6 MILLION TO 12.5 MILLION EQUIVALENT BARRELS OF OIL PER DAY UNDER THE BEPS PROGRAM. THE FACT THAT THE CONGRESS WAS CONCERNED WITH "BARRELS OF OIL EQUIVALENTS" LEADS US TO BELIEVE THAT DOE FELT IT NECESSARY TO ASSESS THE ENTIRE NATION'S ENERGY CONSUMPTION IN TERMS OF "EQUIVALENT BARRELS OF OIL". TO ACCOMPLISH THIS IT WAS NECESSARY TO INVESTIGATE ALL AVAILABLE FUEL TYPES AND THEIR USES. IN SO DOING DOE DISCOVERED THE ENORMOUS INEQUITY OF EXISTING FUEL TO ENERGY PROCESSING AND TRANSPORTATION DEMANDS. WE CANNOT FAULT DOE FOR THEIR INTEREST AND CONCERN IN THIS AREA. HOWEVER, THE ATTEMPT TO ALTER EXISTING PATTERNS OF FUEL USAGE THROUGH BEPS IS CLEARLY BEYOND THEIR AUTHORITY.

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Q. WAS DOE'S SELECTION OF THE WEIGHTING FACTORS (FROM AMONG THE THREE ALTERNATIVES CONSIDERED NATIONALLY) RELATED TO THE PURPOSE AND FINDINGS OF CONGRESS IN ECPA.

A. ALTHOUGH THE SELECTION OF THE SPECIFIC WEIGHTING FACTORS APPEARS RATIONAL, WE BELIEVE THAT THIS IS NOT RELATED TO THE PURPOSE OR SCOPE OF THE ECPA.

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Q. WILL THE USE OF WEIGHTING FACTORS PREVENT LARGE AMOUNTS OF FUEL AND ENERGY FROM BEING CONSUMED UNNECESSARILY EACH YEAR IN HEATING, COOLING, VENTILATING, AND PROVIDING DOMESTIC HOT WATER FOR NEWLY CONSTRUCTED RESIDENTIAL AND COMMERCIAL BUILDINGS?

A. WE BELIEVE THAT THE WEIGHTING FACTORS WILL NOT PREVENT LARGE AMOUNTS OF FUELS AND ENERGY FROM BEING CONSUMED BECAUSE THE APPLICATION OF NATIONAL WEIGHTING FACTORS IS TOTALLY UNREALISTIC AND IMPRACTICAL.

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Q. WILL THE USE OF WEIGHTING FACTORS INSURE THAT NEW BUILDINGS CONTAIN "ADEQUATE ENERGY CONSERVATION FEATURES"?

A. ABSOLUTELY NOT. THERE IS NO RELATIONSHIP BETWEEN WEIGHTING FACTORS AND THE REQUIREMENT FOR "ADEQUATE ENERGY CONSERVATION FEATURES".

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Q. WILL THE USE OF WEIGHTING FACTORS INSURE THE MAXIMUM PRACTICABLE IMPROVEMENTS IN ENERGY EFFICIENCY AND INCREASES IN THE USE OF NONDEPLETABLE SOURCES OF ENERGY?

A. ABSOLUTELY NOT. IT IS IMPOSSIBLE TO "INSURE" INCREASES IN THE USE OF NONDEPLETABLE SOURCES OF ENERGY. IMPROVEMENTS IN ENERGY EFFICIENCY WITHIN BUILDINGS BEARS NO RELATIONSHIP TO THE USE OF WEIGHTING FACTORS.

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Q. DID CONGRESS INTEND BEPS TO INCLUDE WEIGHTING FACTORS IF THEIR USE WOULD NOT SIGNIFICANTLY AFFECT THE OVERALL ENERGY SAVINGS EXPECTED TO BE ACHIEVED BY THE STANDARDS?

A. NO.

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Q. WOULD CONGRESS HAVE INTENDED THAT WEIGHTING FACTORS BE INCORPORATED IN BEPS IF THEIR USE WAS NOT LIKELY TO SIGNIFICANTLY AFFECT A BUILDING DESIGN THAT IS IN COMPLIANCE WITH THE STANDARDS?

A. NO. ACEC BELIEVES THAT THE PROPOSED WEIGHTING FACTORS BEAR LITTLE IF ANY RELATIONSHIP TO THE BUILDING DESIGN.

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Q. DID CONGRESS INTEND THAT WEIGHTING FACTORS BE INCLUDED IN BEPS IF THE SAME OVERALL (SOURCE) ENERGY SAVINGS COULD BE ACHIEVED USING DESIGN ENERGY BUDGETS WITHOUT WEIGHTING FACTORS?

A. THE CONGRESS DID NOT INTEND BEPS TO ENCOMPASS SOURCE ENERGY SAVINGS.

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Q. IS DOE ACTING OUTSIDE OF ITS STATUTORY AUTHORITY BY INCORPORATING IN BEPS WEIGHTING FACTORS FOR NONRENEWABLE SOURCES OF ENERGY THAT "EXPLICITLY ACCOUNT FOR THE COST OF FUELS AND THE VALUE TO THE NATION OF CONSERVING DIFFERENT NONRENEWABLE FUELS"?

A. YES.

Q. IN LIGHT OF THE FACT THAT THE NOPR STATES THAT WEIGHTING FACTORS WILL PROMPT A DESIGNER TO REDUCE THE USE OF ELECTRICITY WHERE TRADEOFFS MUST BE MADE, DOES ECPA EXPRESS ANY PREFERENCE FOR WHICH FORM OF ENERGY IS USED IN A BUILDING?

A. ACEC FINDS NO SUCH PREFERENCE IN THE LAW OR IN THE LEGISLATIVE HISTORY.

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Q. DOES ECPA AUTHORIZE DOE TO DETERMINE A PREFERENCE FOR WHICH FORM OF ENERGY SHOULD BE USED IN A BUILDING?

A. WE BELIEVE THAT NO SUCH AUTHORITY EXISTS IN THE ECPA.

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Q. WOULD CONGRESS HAVE INTENDED THAT WEIGHTING FACTORS BE INCLUDED IN BEPS IF THEIR SOLE EFFECT WAS TO INFLUENCE A DESIGNER TO SAVE ONE OR ANOTHER TYPE OF FUEL WHEN FACED WITH THAT OPTION DURING THE DESIGN PROCESS?

A. THIS IS A DIFFICULT QUESTION TO ANSWER, BUT OUR OPINION IS THAT THE CONGRESS WOULD NEVER HAVE INTENDED DESIGNERS TO MAKE DECISIONS ON AVAILABLE FUEL TYPES. WHEN FACED WITH OPTIONAL FUEL TYPE DECISIONS (AS SELDOM OCCURS) DESIGNERS ADVISE THE OWNER AS TO THE MOST ECONOMICAL FORM OF ENERGY TO OPERATE THE FACILITY. SUCH ADVICE IS OFFERED TO PROTECT THE CLIENT'S INTEREST ONLY. THE CLIENT ACTUALLY DECIDES WHAT HE CAN AFFORD AND WHAT HIS PREFERENCES ARE.

Q. DID CONGRESS INTEND THAT BEPS INFLUENCE THE MIX OF FUEL TYPES SAVED?

A. WE FIND NO EVIDENCE THAT CONGRESS INTENDED BEPS TO HAVE THIS INFLUENCE.

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Q. DID CONGRESS DELEGATE AUTHORITY TO DOE IN ECPA TO INCORPORATE A FUELS MANAGEMENT PROGRAM IN BEPS?

A. NO. SUCH AUTHORITY WAS NOT DELEGATED BY ECPA. THE ESTABLISHMENT OF A NATIONAL FUELS MANAGEMENT PROGRAM REMAINS THE RESPONSIBILITY OF THE CONGRESS AND IS CLEARLY BEYOND THE TITLE III FUNCTIONS WHICH REQUIRE BEPS.

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Q. IS CONGRESS' CHOICE OF LOCAL BUILDING CODES AS A VEHICLE FOR IMPLEMENTING BEPS CONSISTENT WITH A CONGRESSIONAL INTENT TO HAVE BEPS REFLECT FUEL COSTS AND THE VALUE TO THE NATION OF CONSERVING DIFFERENT FUELS?

A. THE USE OF LOCAL BUILDING CODES TO IMPLEMENT BEPS IS INCONSISTENT WITH ANY INTENT TO INFLUENCE FUEL COSTS. WHILE WE FIND NO INDICATION THAT CONGRESS INTENDED FOR BEPS TO REFLECT FUEL COSTS AND "VALUE TO THE NATION" OF DIFFERENT FUEL TYPES, WE BELIEVE THAT SUCH RESPONSIBILITY RESTS WITH THE STATE ENERGY OFFICES IN COOPERATION WITH THE STATE GOVERNOR. THROUGH THE

THE STATE ENERGY PLANS AND PENDING LEGISLATION TO EXTEND FEDERAL-STATE ENERGY MANAGEMENT COOPERATION, SUCH AUTHORITY TO ALTER FUEL USE MAY EXIST. WHILE FUNDS FOR IMPLEMENTATION OF BEPS IS PART OF THE PROPOSED FEDERAL STATE ENERGY MANAGEMENT PARTNERSHIP ACT (S.1280/H.R. 4382), WE BELIEVE SUCH FUNDS ARE RESERVED FOR EDUCATING DESIGNERS, CODE OFFICIALS, AND OTHERS, AS WELL AS FOR ADMINISTRATIVE FUNCTIONS NECESSARY TO MONITOR AND UPDATE THE STANDARDS ON A STATE BY STATE BASIS. IT IS OUR OPINION THAT STATE BUILDING CODES, LOCAL BUILDING CODES, CODE OFFICIALS, INSPECTORS, AND CONSTRUCTION PERMIT GRANTING OFFICIALS HAVE NO RELATIONSHIP WHATSOEVER WITH A NATIONAL FUEL USE POLICY. TO THINK THAT BUILDING CODES OR CODE ENFORCEMENT OFFICIALS WOULD EVER BE CAPABLE OF INFLUENCING THE TYPE OF FUEL TO BE USED IN A BUILDING OR, IN EFFECT, CONTROL THE LOCATION AND TYPE OF UTILITY SERVICES AVAILBLE IN THEIR REGION IS LUDICROUS.

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Q. IS THE USE OF WEIGHTING FACTORS IN BEP'S CONTRARY TO THE CONCEPT OF PERFORMANCE STANDARDS INTENDED BY CONGRESS? DO WEIGHTING FACTORS DICTATE A DESIGNER'S FUEL CHOICES IN A MANNER INCONSISTENT WITH THE CONCEPT OF PERFORMANCE STANDARDS?

A. NO. THE USE OF WEIGHTING FACTORS IS NOT CONTRARY TO THE CONCEPT OF PERFORMANCE STANDARDS INTENDED BY CONGRESS, IT IS SIMPLY BEYOND THE SCOPE OF TITLE III REQUIREMENTS. WEIGHTING FACTORS WILL CLEARLY DICTATE FUEL CHOICES UNDER THE STANDARDS - BUT WE CONSIDER THIS INCONSISTENT WITH THE CONCEPT OF A PERFOR-

MANCE STANDARD. HOW A BUILDING PERFORMS (ITS THERMAL CHARACTERISTICS) IS AN ENTIRELY SEPARATE ISSUE FROM THE CHOICE OF FUEL TO BE USED.

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Q. DOES ECPA AUTHORIZE THE INCORPORATION OF PRICE PREMIUMS FOR OIL AND GAS IN FORMULATING THE WEIGHTING FACTORS?

A. NO.

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Q. HAS DOE EXCEEDED ITS STATUATORY AUTHORITY BY INCLUDING IN BEPS ENERGY CONSUMING SYSTEMS BEYOND THOSE FOR HEATING, COOLING, VENTILATING, AND PROVIDING DOMESTIC HOT WATER FOR NEWLY CONSTRUCTED BUILDINGS?

A. ONLY IN THE SENSE THAT DOE HAS INCLUDED EFFICIENCY CHARACTERISTICS OF THE THREE MAJOR FUEL TYPES. THE BEPS ARE INTENDED TO ENCOURAGE ENERGY CONSERVATION IN ALL BUILDING SYSTEMS. THE EFFICIENCY OF VARIOUS HEATING, COOLING, VENTILATING, HOT WATER, SOLAR, HEAT PUMPS AND RELATED SYSTEMS OR COMBINATION OF SYSTEMS IS CERTAINLY WITHIN THE STATUATORY AUTHORITY FOR THE BEPS.

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Q. ARE DOE'S "EXPLICIT NATIONAL POLICY DETERMINATIONS" CONSISTENT WITH THE ENERGY POLICIES EXPRESSED BY THE ADMINISTRATION AND CONGRESS IN VARIOUS PIECES OF ENERGY LEGISLATION?

A. THE DISCUSSION OF WEIGHTING FACTORS TO REDUCE CONSUMPTION OF CERTAIN NONRENEWABLE FUEL TYPES IS CONSISTENT WITH ENERGY POLICIES ESTABLISHED BY THE NATIONAL ENERGY CONSERVATION POLICY ACT (NECPA), THE PUBLIC UTILITY REGULATORY POLICIES ACT (PURPA) AND THE POWERPLANT AND INDUSTRIAL FUEL USE ACT (PIFUA). HOWEVER, THE IMPLEMENTATION OF THE NATIONAL WEIGHTING FACTORS SET FORTH IN THE PROPOSED RULE WILL DISCRIMINATE AGAINST COAL-FIRED AND NUCLEAR (STEAM BASED) ELECTRIC GENERATING POWERPLANTS. THE USE OF ELECTRICITY IS TREATED WITH AN EFFICIENCY FACTOR OF APPROXIMATELY 31% (3.08). WHILE WE AGREE WITH THE ACCURACY OF THIS FIGURE, WE CANNOT BELIEVE THAT DOE WOULD PROPOSE TO REDUCE ELECTRIC GENERATING CAPACITY AT A TIME WHEN THE CARTER ADMINISTRATION IS PROPOSING AN INCREASE IN THE NUMBER OF POWERPLANT CONVERSIONS FROM OIL-FIRED TO COAL-CAPABLE. IN THIS REGARD THE WEIGHTING FACTOR FOR ELECTRICITY DOES CONTRADICT OUR NATIONAL GOALS. SIMILARLY, THE WEIGHTING FACTOR FOR OIL AT APPROXIMATELY 80% EFFICIENCY (1.20) CLEARLY ENCOURAGES THE USE OF OIL-FIRED FURNACES AND BOILER EQUIPMENT IN SELF-CONTAINED RESIDENTIAL AND COMMERCIAL APPLICATIONS. AGAIN, THIS IS CONTRARY TO OUR NATIONAL GOAL TO REDUCE DEPENDENCE UPON DEPLETABLE SOURCES OF ENERGY.

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Q. WILL THE PROPOSED BEPS RESULT IN THE INCREASED USE OF OIL AND NATURAL GAS BY NEW BUILDINGS? IF SO, HOW IS THIS CONSISTENT WITH NATIONAL ENERGY POLICIES?

A. YES, IT INCREASES OIL AND GAS USEAGE. THIS IS INCONSISTENT WITH OUR NATIONAL ENERGY GOALS AS STATED ABOVE.

Q. WILL THE PROPOSED BEPS DISCOURAGE THE INCREASED USE OF COAL AND OTHER ALTERNATE FUELS AS PRIMARY ENERGY SOURCES AT ELECTRIC POWERPLANTS? IF SO, HOW IS THIS CONSISTENT WITH NATIONAL ENERGY POLICIES?

A. YES. THE WEIGHTING FACTORS PROPOSED FOR ELECTRICITY WILL DISCOURAGE THE INCREASED USE OF COAL IN COAL-FIRED, STEAM-BASED ELECTRIC GENERATION PLANTS. THIS IS INCONSISTENT WITH RECENT INITIATIVES TO INCREASE THE CONVERSION OF OIL-FIRED POWERPLANTS TO COAL WITH THE EXPECTATION THAT AN ADDITIONAL 50 GW OF ELECTRIC CAPACITY WILL BE REQUIRED BY 1990. PLEASE NOTE THAT NO WEIGHTING FACTOR IS PROPOSED FOR COAL-FIRED RESIDENTIAL HEATING. WE SUSPECT THIS IS DUE TO THE PRESENT SCARCITY OF SUCH EQUIPMENT AND THE INFLUENCE OF AIR QUALITY STANDARDS IMPOSED BY EPA.

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Q. IS DOE'S TREATMENT OF HYDRO-ELECTRICITY RATIONAL?

A. IT IS ACEC'S OPINION THAT DOE'S TREATMENT OF HYDRO-ELECTRIC GENERATION IS TOTALLY IRRATIONAL. IT WOULD APPEAR THAT DOE IS ATTEMPTING TO MINIMIZE THE AMOUNT OF WASTED ENERGY REQUIRED TO GENERATE ELECTRICITY PURELY ON A DIRECT BTU/BTU COMPARISON OF INPUT TO OUTPUT. WHILE IT IS A FACT THAT OIL-FIRED ELECTRIC GENERATION REQUIRES 3 BTU'S OF EQUIVALENT ENERGY TO PRODUCE 1 BTU OF ELECTRIC POWER, DOE FAILS TO DISTINGUISH BETWEEN OIL AS A NON-RENEWABLE SOURCE OF INPUT AND HYDRO-POWER AS A CONSTANTLY RENEWABLE SOURCE OF INPUT WITH A HIGHER EFFICIENCY AND MINIMAL ADVERSE ENVIRONMENTAL IMPACTS.

Q. IS SUCH TREATMENT INCONSISTENT WITH CONGRESSIONAL ACTION IN PURPA?

A. IN PURPA CONGRESS TOOK STEPS TO INCREASE THE USE OF HYDROELECTRIC POWER. THE IMPACT OF THE BEPS WEIGHTING FACTORS FOR ELECTRICITY CONTRADICTS THE INTENT OF PURPA.

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Q. IS THE ADDITION OF A PREMIUM FOR OIL AND GAS INCONSISTENT WITH THE FACT THAT WEIGHTING FACTORS WILL MORE LIKELY ENCOURAGE DESIGNERS TO USE OIL AND GAS?

A. NOT ONLY IS THE ADDITION OF SUCH A PREMIUM INCONSISTENT WITH THE PROPOSED WEIGHTING FACTORS BUT IT APPEARS THAT BY ENCOURAGING RECOGNITION OF "A BARREL OF OIL SAVED IS WORTH MORE TO THE NATION THAN ITS PRICE REFLECTS" IS ANOTHER INDICATION THAT DOE HAS STEPPED FAR BEYOND ITS ASSIGNED TASK, TO DEVELOP PERFORMANCE STANDARDS FOR BUILDING DESIGN, INTO AN AREA OF POLICYMAKING RESERVED FOR CONGRESS AND PREVIOUSLY ADDRESSED BY THE POWERPLANT AND INDUSTRIAL FUEL ACT (PIFUA). DOE SHOULD DISENGAGE ITSELF FROM THESE PERIPHERAL ISSUES AND GET DOWN TO THE BUSINESS AT HAND - REGULATING ENERGY CONSUMPTION IN NEW CONSTRUCTION.

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Q. WILL BEPS, BY IMPOSING A WEIGHTING FACTOR OF APPROXIMATELY 3 AGAINST ELECTRICITY, RETARD THE GROWTH OF COGENERATION?

A. SECTION 210 OF PURPA REQUIRES DOE TO ENCOURAGE COGENERATION. IT IS OUR OPINION THAT INADEQUATE RESEARCH WAS DONE TO ADDRESS EXISTING COGENERATION TECHNIQUES IN PREPARATION FOR BEPS. OF THE PHASE II RESEARCH SAMPLE (168 BUILDINGS) NONE WERE STUDIED FOR POTENTIAL COGENERATION CHARACTERISTICS. HEAT OF COMBUSTION, PARTICULARLY IN OIL AND GAS FIRED FURNACE APPLICATIONS SHOULD RECEIVE SOME TYPE OF PREFERENTIAL TREATMENT (OR CREDIT) TO ENCOURAGE COGENERATION APPLICATIONS. WE QUESTION DOE'S STATEMENT THAT THE STANDARDS REFLECT "PRACTICABLE" CONSERVATION EFFORTS ACHIEVABLE BY DESIGNERS THROUGH COMMERCIALLY AVAILABLE TECHNOLOGY. COGENERATION TECHNIQUES ARE AVAILABLE AND SHOULD BE MORE THOROUGHLY TREATED IN THE FINAL RULEMAKING.

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Q. ARE BEPS IN CONFLICT WITH THE FERC REGULATIONS IMPLEMENTING S210 OF PURPA?

A. THE FEDERAL ENERGY REGULATORY COMMISSION WAS AUTHORIZED TO REGULATE AND CONTROL FUTURE PUBLIC UTILITY CONSUMPTION PLANS. THE BEPS DOES APPEAR TO BE IN CONFLICT WITH FERC REGULATIONS THROUGH THE USE OF WEIGHTING FACTORS.

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Q. DOE IS PRESENTLY CONDUCTING, OR CONSIDERING CONDUCTING, ADDITIONAL RESEARCH IN A NUMBER OF AREAS, AND IT MAY USE THE RESULTS OF THIS RESEARCH TO FASHION THE FINAL STANDARDS. ACEC

IS CONCERNED THAT THE REMAINING RESEARCH MAY OFFER ADDITIONAL INFORMATION OF GREAT IMPORTANCE TO THE FINAL RULEMAKING. WILL DOE MAKE THE RESULTS OF THIS ADDITIONAL RESEARCH PUBLIC AND PROVIDE AN OPPORTUNITY FOR COMMENT?

A. IN THE NOPR THERE ARE SEVERAL REFERENCES OT THE FACT THAT DOE INTENDS TO USE INFORMATION GENERATED BY THE ONGOING RESEARCH IN THE FINAL RULE. SUCH INFORMATION MAY SUBSTANTIALLY ALTER 1) ENERGY BUDGET LEVELS, 2) CALCULATION TECHNIQUES, 3) CERTAIN ASSUMPTIONS ABOUT INFILTRATION RATES, 4) CERTAIN ASSUMPTIONS ABOUT INDOOR AIR CONTAMINANTS, 5) EQUIVALENCE DETERMINATION PROCEDURES FOR ALTERNATIVE APPROACHES (ASHRAE 90-75), 6) ESTABLISHED BUILDING CLASSIFICATIONS, 7) METHODS·FOR UTILIZING WEIGHTING FACTORS, 8) PASSIVE AND ACTIVE SOLAR CREDITS, 9) DEGREE DAY FIGURES, 10) STANDARD BUILDING OPERATING CONDITIONS, 11) PROJECTIONS OF FUTURE FUEL PRICING, 12) OTHER ECONOMIC ASSUMPTIONS. THIS ONGOING RESEARCH EFFORT REVEALS TO US THAT DOE DEVELOPED AND PRODUCED A PREMATURE NOTICE OF PROPOSED RULEMAKING IN RESPONSE TO THE CONGRESSIONAL TIMETABLE. THE HASTY EFFORT TO PUBLISH A PROPOSED RULE CAUSED DOE TO PREMATURELY ARRIVE AT CONCLUSIONS WITH LITTLE OR NO SUPPORTING MATERIAL. ACEC IS DISTRESSED BY THIS UNFORTUNATE SET OF CIRCUMSTANCES AND WE APPEAL TO THE SECREATARY OF ENERGY TO DELAY THE FINAL RULEMAKING BY REQUESTING SUCH AUTHORITY FROM THE CONGRESS. IN THE ABSENCE OF SUCH AUTHORITY WE FIND IT DIFFICULT TO IMAGINE ACCEPTANCE OF THE STANDARDS BY ANY SEGMENT OF THE BUILDING INDUSTRY BECAUSE THE FINAL RULE

WILL CONTAIN FACTS AND FIGURES NEVER BEFORE SEEN BY THE PUBLIC THROUGH THE NORMAL PUBLIC REVIEW PROCESS. THE PUBLIC HAS A RIGHT TO EXAMINE ALL MATERIALS WHICH WILL JUSTIFY THE FINAL RULE.

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Q. WILL THE USE OF ALL OR ANY PART OF THE ADDITIONAL RESEARCH, IN ANY WAY, AS A BASIS FOR THE FINAL RULE INVALIDATE THE RULEMAKING?

A. IT IS ENTIRELY POSSIBLE THAT BY DOE'S FAILURE TO OFFER ANOTHER OPPORTUNITY FOR THE PUBLIC TO EXAMINE A "REVISED NOTICE OF PROPOSED RULEMAKING", INCLUDING CHANGES WHICH RESULT FROM THE ONGOING RESEARCH, A SERIOUS VIOLATION OF THE FEDERAL ADMINISTRATIVE PROCEDURES ACT WOULD RESULT. SUCH A VIOLATION MAY INVALIDATE ALL OR PART OF THE FINAL RULEMAKING.

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Q. DOE IS SPECIFICALLY CONSIDERING ADDITIONAL RESEARCH RELATING TO SINGLE-FAMILY RESIDENCE ON THE FOLLOWING TOPICS: LIFE-CYCLE COSTS FOR 32 SMSA'S, LIFE-CYCLE COST ANALYSES OF RESIDENTIAL EQUIPMENT (E.G., FURNACES, AIR-CONDITIONERS, HEAT PUMPS AND WATER HEATERS), AND ANALYSIS OF ADDITIONAL PROTOTYPES. SINCE THE ADDITIONAL RESEARCH MAY REFLECT THE UNDERLYING BASIS FOR THE PROPOSED STANDARDS, HOW CAN ANY AFFECTED GROUP BE EXPECTED TO COMMENT INTELLIGENTLY ON THE STANDARDS UNTIL ALL RESEARCH IS COMPLETED AND SUBJECTED TO PUBLIC COMMENT?

A. NO AFFECTED GROUP CAN BE EXPECTED TO INTELLIGENTLY COMMENT ON MATERIAL THEY HAVE NEVER SEEN.

Q. WILL FINAL RULES BE BASED ON ADEQUATE DATA IF THE PROPOSED ADDITIONAL RESEARCH IS NOT PERFORMED?

A. IN ACEC'S OPINION, AS STATED EARLIER, THE ORIGINAL RESEARCH SAMPLE WAS EXTREMELY SMALL. FURTHERMORE, THE NOPR CONTAINS NUMEROUS ASSUMPTIONS SET FORTH WITHOUT SUPPORTING DOCUMENTATION. AS PROPOSED, THE RULEMAKING IS NOT BASED ON ADEQUATE DATA AND ADDITIONAL RESEARCH IS NECESSARY.

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Q. SHOULD DOE EXPAND THE CURRENT STUDY OF 10 SMSA'S AND CITIES TO 78 SMSA'S AND CITIES FOR LIFE-CYCLE COST ANALYSIS?

A. YES. EVEN THOUGH LIFE-CYCLE COST ANALYSIS TECHNIQUES ARE HIGHLY SPECULATIVE, A BROADER STUDY IS IN ORDER TO BETTER DETERMINE REGIONAL AND METROPOLITAN DEVIATIONS.

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Q. WHEN DOES DOE PLAN TO BEGIN THIS RESEARCH? WHEN WILL IT BE COMPLETED?

A. IT IS OUR UNDERSTANDING THAT SUCH RESEARCH IS ALREADY UNDERWAY. WE HAVE BEEN UNABLE TO LEARN OF A PLANNED COMPLETION DATE.

Q. THE NOPR STATES THAT DOE INTENDS TO UPDATE THE FINAL STANDARDS PERIODICALLY. CAN THESE UPDATES ONLY BE MADE THROUGH FORMAL RULEMAKINGS WITH PUBLIC NOTICE AND OPPORTUNITY FOR COMMENT?

A. THE UPDATES MUST FOLLOW PROCEDURES ESTABLISHED BY THE FEDERAL ADMINISTRATIVE PROCEDURES ACT - AS AMENDED.

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Q. DOE HAS NOT PROPOSED STANDARDS FOR RESTAURANTS, INDUSTRIAL BUILDINGS AND MOBILE HOMES BECAUSE OF INADEQUATE RESEARCH. CAN DOE LEGALLY EXCLUDE THESE TYPES OF BUILDINGS FROM THE FINAL STANDARDS?

A. THE LAW (P.L. 94-385) IS QUITE CLEAR. THE DEPARTMENT OF ENERGY MUST DEVELOP AND PROMULGATE "PERFORMANCE STANDARDS FOR NEW COMMERCIAL AND RESIDENTIAL BUILDINGS". WE INTERPRET THIS AS AN ALL-INCLUSIVE REQUIREMENT.

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Q. MAY DOE VALIDLY PROPOSE CALCULATION METHODS FOR USE IN THE STANDARD EVALUATION·TECHNIQUE THAT ARE NOT YET AVAILABLE BUT MERELY IN THE PLANNING STAGE AT THIS TIME?

A. NO LAW THAT WE ARE AWARE OF PROHIBITS DOE FROM PROPOSING CALCUATION METHODS FOR USE IN THE STANDARD EVALUATION TECHNIQUE. HOWEVER, THE PRACTICALITY OF SUCH A PROPOSAL CAN BE CHALLENGED.

AS STATED IN THE NOPR, DOE IS BASING THE PROPOSED RULE ON "CURRENT TECHNOLOGY" AND, ENCOURAGING "ACCELERATED USE OF ENERGY CONSERVING AND RENEWABLE RESOURCE TECHNOLOGIES". THE PROPOSED STANDARD EVALUATION TECHNIQUE HEAVILY FAVORS PRESCRIBED COMPUTER ANALYSIS THROUGH THE USE OF DOE-II, TRNSYS, AND DEROB COMPUTER PROGRAMS. NONE OF THESE PRESCRIBED PROGRAMS ARE WIDELY USED BY DESIGNERS OF NEW BUILDINGS. SUCH A REQUIREMENT DOES NOT REFLECT THE "STATE OF THE ART" OF NEW BUILDING DESIGN, BUT MERELY ISOLATED CASES OF LARGELY EXPERIMENTAL DESIGN EVALUATION. WE RECOGNIZE THAT DOE INTENDS TO "APPROVE" MANUAL CALCULATION TECHNIQUES AS A SUBSTITUTE APPROACH.

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ACEC MUST POINT OUT THAT THE LAW DOES NOT REQUIRE DOE TO ESTABLISH ANY "STANDARD EVALUATION TECHNIQUE". THE LAW SIMPLY STATES THAT DOE MUST DEVELOP "PERFORMANCE STANDARDS" ... "WITHOUT SPECIFICATION OF THE METHODS, MATERIALS, AND PROCESSES TO BE EMPLOYED" ... THE SPECIFIC REQUIREMENT FOR USE OF ONE OF THE COMPUTER PROGRAMS SET FORTH IN THE PROPOSED RULE IS IN DIRECT VIOLATION OF THIS MANDATE. DOE MAY HOWEVER, STATE "EVALUATION METHODS TO BE USED". WE CONTEND THAT THE USE OF COMPUTERS IS ONE METHOD. THE USE OF MANUAL CALCULATIONS IS ANOTHER METHOD. DOE IS NOT AUTHORIZED TO DEVELOP AND PRESCRIBE SPECIFIC COMPUTER TECHNIQUES OR SPECIFIC MANUAL TECHNIQUES. DOE IS CERTAINLY NOT AUTHORIZED TO "STANDARDIZE" ANYTHING IN THIS REGARD.

Q. IN LIGHT OF THE ADDITIONAL RESEARCH DOE HAS PLANNED, HOW VALID ARE THE ECONOMIC, ENVIRONMENTAL AND REGULATORY ANALYSES DOE HAS PERFORMED TO DATE?

A. THE INFORMATION MADE AVAILABLE TO US, IN DRAFT FORM, INDICATES A SINCERE EFFORT TO EXPLORE AN ENORMOUS AMOUNT OF RELEVANT INFORMATION. HOWEVER, DUE TO TIME LIMITATIONS AND INADEQUATE FUNDS, WE BELIEVE MUCH OF THE MATERIAL IN THE TECHNICAL SUPPORT DOCUMENTS TO BE THE PRODUCT OF EDUCATED GUESSWORK AND LOGICAL ASSUMPTIONS. FURTHER VERIFICATION OF THE RESEARCH IS NECESSARY. IN LIGHT OF THIS FACT, THE ECONOMIC, ENVIRONMENTAL AND REGULATORY ANALYSES CANNOT BE TERMED "VALID". WHILE THE PROPOSED IMPLEMENTATION REGULATIONS ARE NOT AVAILABLE, THE NOPR INDICATES THAT THE FINAL RULE WILL INCLUDE A SECTION ON PROCEDURES FOR ADMINISTRATIVE INTERPRETATIONS OF, AND EXCEPTIONS TO, THE FINAL STANDARDS. WITH RESPECT TO THESE EXCEPTIONS WE ARE ANXIOUS TO LEARN THE ANSWERS TO THE FOLLOWING QUESTIONS:

A. WILL THEY BE FLEXIBLE ENOUGH TO ACCOMODATE A WIDE RANGE OF UNFORSEEN PROBLEMS?
B. WILL THEY BE FORMAL OR INFORMAL? WILL APPLICANTS FOR RELIEF REQUIRE THE SERVICES OF LEGAL COUNSEL?
C. WILL THEY BE ADMINISTERED ON A LOCAL, STATE, REGIONAL OR NATIONAL BASIS?
D. WILL THEY BE ADMINISTERED BY DOE OR BY AN INDEPENDENT BODY (E.G., THE NATIONAL INSTITUTE OF BUILDING SCIENCES)?

E. WHAT ASSURANCES WILL BE PROVIDED THAT CASES ARE TO BE HANDLED IN AN EXPEDITIOUS MANNER THAT WILL PREVENT DELAYS IN CONSTRUCTION?

F. WHAT TYPE OF APPELLATE REVIEW OF EXEMPTION WILL BE PROVIDED? WILL THERE BE ANY OPPORTUNITY FOR JUDICIAL REVIEW OF UNFAVORABLE DECISIONS?

G. WHO WILL BE ELIGIBLE TO APPLY FOR AN EXEMPTION? ONLY DESIGNERS?

THE NOPR OUTLINES FIVE AREAS WHERE DOE EXPECTS TO CONSIDER EXEMPTION REQUESTS. THESE INCLUDE DESIGNS INVOLVING: 1) SPECIAL HEALTH AND SAFETY REQUIREMENTS; 2) UNIQUE CLIMATE CONDITIONS; 3) DIFFICULT PROBLEMS IN CALCULATING DESIGN ENERGY CONSUMPTION; 4) UNIQUE BUILDING CLASSIFICATIONS; AND 5) OTHER MATTERS OF CONCERN , AS DETERMINED BY DOE.

A. WHAT IS THE SCOPE OF EACH OF THE FOUR AREAS SPECIFICALLY DEFINED?

B. DOES THE SCOPE OF THE EXEMPTIONS PROCESS NEED TO BE BROADENED TO ACCOUNT FOR SPECIAL CONCERNS PERTINENT TO VARIOUS FACETS OF THE ELECTRICAL INDUSTRY? IF SO, HOW?

C. WILL THE EXEMPTIONS PROCESS BE ABLE TO ACCOUNT FOR THE INTRODUCTION OF INNOVATIVE ELECTRICAL TECHNOLOGY IN BUILDING DESIGNS, SUCH AS THE HEAT PUMP, AS WELL AS INNOVATIVE TECHNOLOGY IN ELECTRIC GENERATION, SUCH AS THERMAL STORAGE AND LOAD MANAGEMENT?

D. WILL THE EXEMPTIONS PROCESS BE ABLE TO ACCOUNT FOR EXTERNAL EVENTS, SUCH AS AN OIL EMBARGO, THAT COULD IMMEDIATELY AFFECT A DESIGNER'S AVAILABLE FUEL CHOICE?

E. WILL IT BE POSSIBLE, UNDER ANY CIRCUMSTANCES, FOR AN ELECTRICAL UTILITY TO HAVE THE WEIGHTING FACTORS FOR ELECTRICITY LOWERED FOR BUILDING DESIGNS IN ITS SERVICE AREA?

F. SHOULD THE EXEMPTIONS PROCESS BE FORMULATED TO APPROVE INDIVIDUAL DESIGNS THAT ARE LIFE CYCLE COST EFFECTIVE AND ENERGY EFFICIENT BUT WHICH NEVERTHELESS DO NOT COMPLY WITH THE FINAL STANDARDS?

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Q. THE NOPR HAS ESTABLISHED ENERGY BUDGET LEVELS FOR NEW BUILDINGS MEASURED IN TERMS OF ENERGY CONSUMED PER SQUARE FOOT PER YEAR (BTU/SQ.FT./YR.). IS THIS UNIT OF MEASURE APPROPRIATE FOR ALL NEW BUILDINGS? WILL IT PROVIDE CONSISTENT RESULTS?

A. ACEC BELIEVES THAT THE BTU/SQ.FT./YR. MEASURE IS AN APPROPRIATE AND USABLE BASIS. ENGINEERS ARE FAMILIAR WITH BTU VALUES AND IT IS RELATIVELY EASY TO MANUALLY CALCULATE A BTU/SQ.FT. FIGURE. HOWEVER, THE "GROSS SQUARE FOOTAGE" INDICATION IS FAR LESS ACCURATE THAN A "NET SQUARE FOOTAGE" INDICATION DUE TO THE INFLUENCE OF THERMAL MASS AND THE MANY VARIABLES SUCH AS TRANSMISSION COEFFICENTS FOR DIFFERENT MATERIALS, REFLECTIVE SURFACE VALUES, AND BROAD RANGE OF UNPREDICTABLE ORIENTATION VARIABLES. CONSUMPTION FIGURES BASED UPON A NET SQUARE FOOTAGE CALCULATION (ABSENT OF STRUCTURE AND PRIMARY CIRCULATION SPACES) WOULD, OBVIOUSLY, BE

BE MUCH LARGER THAN THE ENERGY BUDGET FIGURES ESTABLISHED IN THE NOPR. A NET SQUARE FOOTAGE CALCULATION MIGHT AVOID PROBLEMS IN THE SELECTION OF AN APPROPRIATE BUILDING CLASSIFICATION. WHEN CONSIDERING ONLY THE FUNCTIONAL CHARACTERISTICS OF OCCUPIED SPACE (NET SQUARE FOOTAGE) IT SHOULD BE EASIER TO DECIDE THE PROPER CLASSIFICATION, AND THE NUMBER OF EXEMPTIONS (I.E., WHEN 50% OF THE GROSS AREA CANNOT BE ASSIGNED) WILL BE SUBSTANTIALLY REDUCED. WE EMPHASIZE THIS POINT BECAUSE CIRCULATION SPACE AND BUILDING MASS CAN EASILY CONSUME 50% OF THE GROSS AREA ALONE. COMMERCIAL BUILDINGS TODAY ARE DESIGNED TO MINIMIZE CIRCULATION SPACE, YET FROM 15% TO 50% OF THIS SPACE IS COMMONLY USED FOR INTERNAL CIRCULATION PURPOSES.

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Q. IS BTU/CU.FT. 3/YR. A MORE APPROPRIATE UNIT OF MEASURE, ESPECIALLY FOR CERTAIN BUILDINGS SUCH AS WAREHOUSES?

A. YES. WAREHOUSES AND OTHER STRUCTURES (INCLUDING SOME COMMERCIAL FACILITIES) WHERE LARGE VOLUMES OF SPACE ARE GIVEN UP TO INTERIOR COURTS, MEZZANINES, GALLERIES, AND CLERESTORIES SHOULD BE EVALUATED ON A NET CUBIC FOOTAGE BASIS FOR MORE ACCURATE RESULTS.

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Q. IS A UNIT OF MEASURE TAILORED TO SPECIFIC BUILDING TYPES (E.G., BTU/BED/YR. FOR HOSPITALS) MORE APPROPRIATE?

A. THE ENERGY REQUIREMENTS FOR SUCH FACILITIES ARE DIFFERENT FROM HOSPITAL TO HOSPITAL. THE PHASE II RESEARCH REVEALS AN EXTREMELY BROAD RANGE OF ENERGY DEMANDS FOR HOSPITALS AND HEALTH CARE ESTABLISHMENTS. THEREFORE, IT IS INAPPROPRIATE TO CALCULATE ENERGY FOR SUCH FACILITIES ON THE BASIS OF THE BED COUNT. IF A NET SQUARE FOOTAGE FIGURE WERE APPLIED, THE RESULTS WOULD BE REASONABLY ACCURATE AND MORE CONSISTENT WITH THE APPROACH ON REMAINING BUILDING TYPES. HOWEVER, ALL "HOSPITALS" ARE NOT ALIKE IN THEIR ENERGY DEMANDS.

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Q. SHOULD THE UNIT OF MEASURE APPLY ONLY TO CONDITIONED SQUARE FEET?

A. CONDITIONED SPACE WOULD INCLUDE THE SIGNIFICANT HEATING AND COOLING DEMANDS FOR "AIR CURTAINS" AT ENTRANCES AND EXITS TO BUILDINGS, BASEMENTS, ELEVATORS, AND OTHER SUCH SPACES. LIGHTING DEMANDS ARE NORMALLY LOW IN THESE SPACES. WHILE SOME INEQUITY WILL EXIST IF LOADS ARE CALCULATED ON THE BASIS OF NET SQUARE FOOTAGE, THE NET FIGURE IS MORE READILY USABLE THAN IDENTIFYING SPECIFIC CONDITIONED SPACES AND ISOLATING THE LOADS IN THOSE AREAS.

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Q. SHOULD THE UNIT OF MEASURE BE BTU/OCCUPANT/YR. OR BTU/FUNCTION/YR.?

A. NO. OCCUPANCY PROFILES AND FUNCTIONS ARE TOTALLY SPECULATIVE AND BEYOND THE CONTROL OF THE DESIGNER.

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Q. SHOULD THE ENERGY BUDGETS SPECIFY A PERFORMANCE RANGE, RATHER THAN A SPECIFIC FIGURE?

A. NO. THE ESTABLISHED BUDGETS (UPPER LIMITS) WILL SERVE THE PURPOSE BETTER THAN A BUDGET RANGE. RANGES SHOULD BE CONSIDERED FOR REQUIRED PARAMETERS WITHIN THE CALCULATION PROCEDURE, (I.E., RANGE OF ACCEPTABLE INFILTRATION RATES, RANGE OF OCCUPANCY TYPES, RANGE OF OPERATING CONDITIONS, RANGE OF DAILY CLIMATE CONDITIONS, ETC.)

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Q. IN THE APPROACH USED FOR DOMESTIC HOT WATER HEATING IS IT APPROPRIATE TO ASSUME AN AVERAGE NUMBER OF RESIDENTS PER HOME?

A. NO. SEPARATE BUDGET LEVELS ARE PROVIDED FOR DOMESTIC HOT WATER HEATING. DOE ASSUMES THAT THE CONSUMPTION LEVELS DO NOT VARY BY REGION AND THAT AN AVERAGE NUMBER OF PEOPLE OCCUPY A HOME REGARDLESS OF HOME SIZE. WHILE THE FIRST ASSUMPTION MAY BE CLOSE TO CORRECT, THE LATTER IS FAR FROM CORRECT. ACEC SERIOUSLY DOUBTS THAT DOE CAN SUCCESSFULLY IMPOSE CRITERIA SUCH AS THIS ON DESIGNERS AND DEVELOPERS AND EXPECT THE RESULTS TO BE CREDIBLE.

Q. WILL ENERGY CONSUMED FOR WATER HEATING VARY FOR TWO CASES WHICH ARE IDENTICAL EXCEPT FOR LOCATION?

A. YES, BUT THE DEGREE OF DEVIATION DEPENDS UPON THE SPECIFIC CLIMATE AND MAY NOT BE SIGNIFICANT. GROUNDWATER TEMPERATURES VARY DRAMATICALLY, AS DO UTILITY SUPPLIED WATER TEMPERATURES.

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Q. WILL ENERGY CONSUMED FOR WATER HEATING VARY FOR TWO CASES WHICH ARE IDENTICAL EXCEPT FOR THE NUMBER OF OCCUPANTS?

A. YES. SUBSTANTIALLY.

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Q. WERE THE TWO PROTOTYPICAL HOUSES USED REPRESENTATIVE OF SINGLE-FAMILY RESIDENCES THROUGHOUT THE UNITED STATES?

A. IT IS BEYOND BELIEF THAT DOE CAN ATTEMPT TO ESTABLISH BUDGETS FOR SINGLE-FAMILY RESIDENCES THROUGHOUT THE UNITED STATES BASED UPON AN ANALYSIS OF ONLY TWO PROTOTYPICAL HOUSES. MUCH MORE RESEARCH IS NECESSARY.

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Q. ARE THE ENERGY BUDGET LEVELS TOO STRINGENT? IS COMPLIANCE PRACTICABLE?

A. ACEC HAS STUDIED THE RESULTS OF AN ANALYSIS PERFORMED UNDER

CONTRACT TO THE NATIONAL ASSOCIATION OF HOME BUILDERS. BASED UPON OUR ASSESSMENT OF THIS WORK, THE STRINGENCY OF BUDGET LEVELS ESTABLISHED IN THE NOPR IS NON-UNIFORM. AS THE NAHB STUDY INDICATES, IN THE MIAMI AREA THERE IS VIRTUALLY NOTHING ONE CAN DO, (REGARDLESS OF WHICH FUEL TYPE IS USED) TO EXCEED THE ESTABLISHED BUDGET LEVELS - EVEN WITHOUT USING INSULATION. THIS IMPLIES THAT THE BUDGETS IN THE MIAMI AREA ARE TOO LOOSE AND WILL NOT ENCOURAGE CONSERVATION. ON THE OTHER HAND, THE STUDY PERFORMED FOR THE MINNEAPOLIS AREA INDICATES THAT NO FUTURE ELECTRIC RESISTANCE HEATING FOR NEW CONSTRUCTION CAN BE CONSIDERED. THIS ANALYSIS WAS RUN ASSUMING A FAIRLY TIGHT BUILDING DESIGN EMPLOYING SEVEN DIFFERENT COMBINATIONS OF INSULATION AND OTHER BUILDING MATERIALS. THE RESULTS SHOW THAT THE TIGHTEST CASE - USING R-60 INSULATION IN THE ROOF, R-19 INSULATION IN THE WALLS, AND THREE LAYERS OF GLASS ON THE WINDOWS WITH THE SPECIFIED .6 AIR CHANGES/HR. - CANNOT BE BUILT TO INCLUDE ELECTRIC RESISTANCE HEATING. SIMILAR RESULTS WERE SHOWN TO FURTHER DISCRIMINATE AGAINST RESISTANCE HEATING IN STUDIES OF THE DENVER, ATLANTA, AND BAKERSFIELD SMSA'S. UNDER THE OTHER TWO FUEL TYPE WEIGHTING FACTORS, COMPLIANCE WAS ACHIEVABLE BUT DIFFICULT.

Q. IS DOE'S DECISION TO GIVE MASONRY CONSTRUCTION THE SAME ENERGY BUDGET LEVELS AS FRAME RESIDENCES VALID?

A. NO. IT IS A FACT THAT MASONRY CONSTRUCTION, BY VIRTUE OF ITS RELATIVE WEIGHT AND DENSITY, HAS FAR GREATER THERMAL RETENTION CHARACTERISTICS THAN WOOD, ALUMINUM, ASBESTOS OR FIBERGLASS. THIS SHOULD HAVE BEEN STUDIED VERY CAREFULLY BY DOE. THE ASSUMPTION

THAT MASONY CONSTRUCTION CAN BE TREATED THE SAME AS FRAME CONSTRUCTION IS INVALID.

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Q. HOW MUCH CONFIDENCE CAN BE PLACED IN ENERGY BUDGETS ESTABLISHED FOR 78 SMSA'S WHEN BUDGETS WERE DEVELOPED FROM DATA EXTRAPOLATED FROM COMPUTER MODELING PERFORMED INITIALLY FOR TEN CITIES?

A. NOT MUCH. ACEC ENCOURAGES DOE TO RUN THE COMPLETE DOE-2 ANALYSIS ON EACH AND EVERY SMSA LISTED IN THE TABLES. IF DOE EXTRAPOLATES TO DETERMINE SPECIFIC REQUIRED BUDGET LEVELS, THEN DESIGNERS SHOULD BE PERMITTED TO ESTIMATE OR APPROXIMATE THE ENERGY CONSUMPTION FOR THEIR DESIGNS.

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Q. THE DESIGN ENERGY BUDGETS FOR THREE PROTOTYPES (SINGLE-STORY, SPLIT LEVEL AND TWO-STORY) WERE SIMILAR AND SO WERE COMBINED. WILL ACTUAL CONSUMPTION VARY AMONG THESE PROTOTYPES FOR DIFFERENT CLIMATIC AREAS?

A. ACEC ANTICIPATES GREAT VARIATIONS AMONG THE THREE PROTOTYPES. THE DECISION TO COMBINE THESE PROTOTYPES SHOULD HAVE FOLLOWED A DECISION TO EXPAND THE RESEARCH SAMPLE TO FURTHER JUSTIFY THIS ACTION.

Q. THE ENERGY BUDGET LEVELS FOR COMMERCIAL AND MULTI-FAMILY RESIDENTIAL BUILDINGS ACCOUNT FOR THE ENERGY CONSUMED FOR HEATING, COOLING, VENTILATION, EXHAUST FANS, ARTIFICIAL LIGHTING, DOMESTIC

HOT WATER, AND ELEVATORS AND ESCALATORS. IS THE INCLUSION OF ENERGY CONSUMPTION FOR ALL THESE BUILDING SYSTEMS PROPER? SHOULD ONLY THE ENERGY CONSUMED BY THE BUILDING SYSTEMS SPECIFICALLY LISTED IN ECPA BE INCLUDED?

A. YES. THIS INFORMATION IS USEFUL. HOWEVER, DOE SHOULD CONSIDER ISOLATING VERTICAL AND HORIZONTAL CIRCULATION SPACES AND ASSIGNING A PERCENTAGE OF THE TOTAL ENERGY CONSUMED IN THESE AREAS TO EACH UNIT SERVICED. AGAIN, A NET SQUARE FOOTAGE CALCULATION IS SUGGESTED.

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Q. SHOULD ENERGY CONSUMING SYSTEMS INCLUDED IN ESTABLISHING ENERGY BUDGET LEVELS BE LIMITED TO THOSE NECESSARY FOR MAINTAINING HUMAN COMFORT CONDITIONS?

A. NO. ALL ENERGY CONSUMING SYSTEMS WHICH ARE WITHIN THE BUILDING LINE SHOULD BE CONSIDERED.

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Q. SHOULD PROCESS ENERGY HAVE BEEN EXCLUDED?

A. NO. ALTHOUGH COMPLEX, A RANGE OF ACCEPTABLE PROCESS LOADS SHOULD BE INCLUDED FOR ALL PROCESSES TAKING PLACE WITHIN THE BUILDING LINE.

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Q. SHOULD ENERGY USED FOR LIGHTING IN RETAIL STORES BE TREATED AS PROCESS ENERGY?

A. NOT NECESSARILY. FIRST CONSIDERATION SHOULD BE GIVEN TO THE CONGENERATION POTENTIAL OF LIGHTING SYSTEMS THROUGH THE USE OF HEAT COLLECTED IN THE PLENUM.

Q. FOR PURPOSES OF HABITABILITY, LIGHTING LEVELS IN OFFICE BUILDINGS NEED ONLY BE 30FC OR SO. FOR PURPOSES OF PRODUCTIVITY, HIGHER LEVELS ARE REQUIRED. SHOULD THE DIFFERENCE BETWEEN THESE TWO LEVELS BE CONSIDERED PROCESS ENERGY NOT SUBJECT TO INCLUSION IN BEPS BUDGETS?

A. NO. THE PROPOSED STANDARDS SHOULD BE THOROUGH ENOUGH TO RECOGNIZE SITE-SPECIFIC REQUIREMENTS FOR LIGHTING BASED UPON PRODUCTIVITY AND FUNCTION. FURTHER RESEARCH IS NEEDED TO DETERMINE THE MAGNITUDE OF POTENTIAL HEALTH-SAFETY VIOLATIONS FOR FAILING TO PROVIDE ADEQUATE LIGHTING LEVELS.

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Q. FOR COMMERCIAL AND MULTI-FAMILY RESIDENTIAL BUILDINGS, DOE ESTABLISHED ENERGY BUDGET LEVELS BASED ON THE EFFICACY OF THE REDESIGNS PERFORMED ON A SAMPLE OF 168 BUILDINGS AND THE EXTENT TO WHICH THE REDESIGNS AFFECTED SIMULATED ENERGY CONSUMPTION. THE REDESIGNS WERE PERFORMED IN 1977-1978. HAVE THERE BEEN SUFFICIENT CHANGES SINCE THAT TIME TO PLACE THE PRESENT VALIDITY OF SUCH REDESIGNS IN QUESTION?

A. ACEC CONTENDS THAT SIMULATIONS SUCH AS THESE BEAR LITTLE OR NO RELATIONSHIP TO ACTUAL PERFORMANCE LEVELS. THE FACT THAT NONE OF THE REDESIGNED BUILDINGS WERE ACTUALLY BUILT TO VERIFY

THE DESIGNED PERFORMANCE MAKES THIS QUESTION MOOT. WE BELIEVE THAT ASHRAE STANDARD 90 , FIRST ISSUED IN 1975 AS A VOLUNTARY CONSENSUS STANDARD, IS ONLY NOW BEGINNING TO HAVE AN IMPACT ON ENERGY CONSUMPTION IN NEW BUILDINGS. THIS IS LARGELY DUE TO THE FACT THAT STATE LEGISLATURES REQUIRED FROM 18 MONTHS TO 3 YEARS TO ENACT LEGISLATION ADOPTING THE ASHRAE STANDARD IN APPROXIMATELY 40 STATES. DESIGNERS BEGAN USING THE ASHRAE STANDARD ONLY RECENTLY TO MEET NEW BUILDING CODE REQUIREMENTS. EVIDENCE DOES EXIST TO INDICATE THAT CONSIDERABLE AMOUNTS OF ENERGY ARE BEING SAVED TODAY BY USING THIS STANDARD WHICH WAS LARGELY UNHEARD OF IN 1975 AND 1976. IN LIGHT OF THIS FACT AND THE RECENT ANALYSIS OF THE ASHRAE STANDARD CONDUCTED BY AIA/RC UNDER CONTRACT TO DOE, WE BELIEVE THAT THE VALIDITY OF THE REDESIGNS CAN BE QUESTIONED.

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Q. IS A SAMPLE OF 168 BUILDINGS ADEQUATE?

A. ABSOLUTELY NOT.

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Q. WERE THE ESTIMATED DESIGN ENERGY REQUIREMENTS BY BUILDING TYPE OBTAINED FROM THE REDESIGN EFFORTS CONDUCTED BY DOE ACCURATE?

A. THE ESTIMATES MAY BE ACCURATE. HOWEVER, A DETERMINATION OF ACCURACY REQUIRES THE EXAMINATION OF ACTUAL DATA. NO ACTUAL DATA EXISTS TO VERIFY THE ESTIMATES. WE DO NOT CONSIDER COMPUTER SIMULATIONS ACCEPTABLE AS A SUBSTITUTE FOR ACTUAL PERFORMANCE LEVELS.

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Q. THE ENERGY BUDGET LEVELS FOR COMMERCIAL AND MULTI-FAMILY RESIDENTIAL BUILDINGS INCORPORATE THE WEIGHTING FACTORS BY APPLYING THEM TO ACTUAL CONSUMPTION LEVELS ON THE BASIS OF AN "AVERAGE" REGIONAL MIX OF FUELS FOR THE BUILDINGS. IS THIS METHODOLOGY APPROPRIATE?

A. NO. ON A BUILDING BY BUILDING DESIGN EFFORT THE AVERAGE REGIONAL FUEL MIXES WILL DISTORT THE ESTIMATES OF ACTUAL PERFORMANCE. VAST DEVIATIONS FROM THE AVERAGE WILL BE MORE NUMEROUS THAN THOSE DESIGNS WHICH MORE NEARLY REFLECT THE ASSIGNED REGIONAL VALUE. IN ASSIGNING ENERGY BUDGET LEVELS FOR COMMERCIAL AND MUTLI-FAMILY RESIDENTIAL BUILDINGS, DOE DEVELOPED SEPARATE LEVELS FOR VARIOUS BUILDING CLASSIFICATIONS. IT APPLIED THE "STRICT" LEVEL (THAT WHICH COULD BE MET BY ONLY 30% OF THE REDESIGNS) TO LARGE AND SMALL OFFICE BUILDINGS; THE "LENIENT" LEVEL (THAT WHICH COULD BE MET BY 70% OF THE REDESIGNS) TO HOSPITALS AND MULTI-FAMILY LOW-RISE RESIDENTIAL BUILDINGS; AND THE "NOMINAL" LEVEL (THAT WHICH COULD BE MET BY 50% OF THE REDESIGNS) TO OTHER COMMERCIAL AND MULTI-FAMILY RESIDENTIAL BUILDINGS. DOE MADE THESE ASSIGNMENTS ON THE BASIS OF AN "INFORMED JUDGMENT OF ALL AVAILABLE INFORMATION".

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Q. SHOULD THE IMPACTS OF THE REDESIGN ON BUSINESS PRODUCTIVITY HAVE BEEN STUDIED?

A. YES.

Q. SHOULD A STUDY HAVE BEEN PERFORMED TO DETERMINE HOW MANY BUILDING DESIGNERS ARE CAPABLE OF PROVIDING THE SERVICES AND CAPABILITIES REQUIRED?

A. YES! IN THE ABSENCE OF A THOROUGH DOE EVALUATION OF 1) ADDITIONAL DESIGN TIME REQUIRED TO MEET THE STANDARDS, AND 2) CAPABILITIES OF PRESENT DAY DESIGN FIRMS, ACEC MUST CONTEST THE PROMULGATION OF THIS NOPR. ASSUMPTIONS AGAIN WERE MADE THAT "SOME" ADDITIONAL DESIGN TIME WILL BE REQUIRED. WE HAVE ESTIMATES TO SHOW THAT FROM 10%-40% ADDITIONAL DESIGN TIME MAY BE NEEDED TO MEET THE REQUIREMENTS OF THE STANDARDS DEPENDING UPON, 1) THE BUILDING TYPE, AND 2) THE FAMILIARITY OF THE FIRM WITH ENERGY CONSCIOUS DESIGN STRATEGIES. AN ANALYSIS OF ADDITIONAL DESIGN TIME SHOULD HAVE BEEN UNDERTAKEN BY THE BATTELLE CORPORATION DURING THE DEVELOPMENT OF THE ECONOMIC IMPACT ANALYSIS.

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Q. SHOULD A STUDY HAVE BEEN PERFORMED TO DETERMINE THE ADDITIONAL FEES ASSOCIATED WITH DESIGNING A BUILDING WHICH MEETS THE STANDARDS?

A. EMPHATICALLY YES!

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Q. WHAT LEVEL OF CONFIDENCE CAN BE PLACED IN THE VARIOUS ENERGY BUDGET LEVELS ESTABLISHED?

A. UNTIL FURTHER COMPUTER VERIFICATIONS, OR ACTUAL CONSUMPTION DATA IS AVAILABLE, VERY LOW.

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Q. IS IT PRACTICABLE TO COMPLY WITH THE ENERGY BUDGET LEVELS?

A. BASED UPON WHAT WE HAVE STUDIED, ACEC BELIEVES IT IS POSSIBLE TO COMPLY WITH THE ENERGY BUDGET LEVELS. THE PRACTICALITY OF SUCH COMPLIANCE IS, AS YET, UNKNOWN. ENGINEERS AND ARCHITECTS COULD CONCEIVABLY BEGIN DESIGNING TO MEET THE REQUIREMENTS OF THE BEPS TODAY. HOWEVER, SUCH DESIGN EFFORTS WILL BE COSTLY. THE COSTS INCURRED BY DESIGNERS MUST BE PASSED ALONG TO THE CLIENT (BUILDING OWNER). THE DEGREE TO WHICH SUCH ADDITIONAL COSTS WILL BE TOLERATED BY A CLIENT BEFORE HE REACHES A DECISION NOT TO BUILD IS A FURTHER UNKNOWN.

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Q. THE NOPR ESTABLISHES A FUNCTIONAL APPROACH FOR A MULTI-USE COMMERCIAL BUILDING WITH THE DESIGN ENERGY BUDGET BEING BASED UPON THE RELATIVE AREAS OR THE FUNCTIONS PRESENT IN THE BUILDING DESIGN. THIS APPROACH IS USED ONLY IF ENERGY BUDGET LEVELS CAN BE ASSIGNED TO AT LEAST 50% OF THE GROSS AREA OF THE BUILDING DESIGN. IF ENERGY BUDGET LEVELS CANNOT BE ASSIGNED TO 50% OF THE GROSS AREA, THE BUILDING IS NOT SUBJECT TO THE STANDARDS. WILL THIS APPROACH ENCOURAGE THE DESIGN AND CONSTRUCTION OF COMMERCIAL BUILDINGS NOT SUBJECT TO BEPS?

A. NO. HOWEVER, NUMEROUS EXEMPTIONS MAY BE SOUGHT BY DESIGNERS WHO CONSTRUE "GROSS SQUARE FOOTAGE" TO BE INAPPROPRIATE FOR THEIR BUILDING.

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Q. WILL THE COMMERCIAL BUILDINGS SO EXEMPTED FROM BEPS CONSUME LARGE AMOUNTS OF ENERGY?

A. NOT UNLESS STATE BUILDING CODES PERMIT EXEMPTIONS FROM ALL APPLICABLE ENERGY STANDARDS. IT IS LIKELY THAT EXISTING STANDARD 90 BASED CODES WILL GOVERN CREATING A FALL BACK POSITION OR EVEN IMPROVEMENTS.

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Q. WILL BEPS ENCOURAGE THE DESIGN AND CONSTRUCTION OF LARGE, ENERGY-EFFICIENT COMMERCIAL BUILDING?

A. YES.

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Q. DO THE FUNCTIONS OF A GIVEN BUILDING CHANGE OVER TIME?

A. YES. THE ENERGY CONSUMPTION CHARACTERISTICS OF A BUILDING WILL CHANGE SIMULTANEOUSLY WITH THE CHANGE IN FUNCTION. DESIGNERS CANNOT BE HELD RESPONSIBLE FOR FUNCTIONAL CHANGES AND, THEREFORE, CANNOT BE HELD RESPONSIBLE FOR ANY FAILURE OF THE BUILDING TO PERFORM AS DESIGNED FOR ENERGY CONSUMPTION.

Q. CAN THE INTERACTIONS OF VARIOUS BUILDING SYSTEMS REQUIRED TO SUPPORT DIFFERENT FUNCTIONS IN DIFFERENT SPACES BE ACCURATELY PROJECTED IN ANY TYPE OF A BUILDING CLASSIFICATION SCHEME?

A. NO. A BUILDING IS A VERY SOPHISTICATED AND HIGHLY SPECIALIZED "MACHINE" WHICH SUPPORTS HUMAN LIFE AND SERVICES THE FUNCTIONS WITHIN ITS BOUNDARIES. EVERY BUILDING IS UNIQUE. THE ENERGY CONSUMING COMPONENTS WITHIN A BUILDING PERFORM DIFFERENTLY IN DIFFERENT COMBINATIONS.

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Q. DOE ADMITS THAT IMPLEMENTATION OF BEPS WILL INCREASE THE FIRST COST OF NEW BUILDING CONSTRUCTION. IS DOE'S ESTIMATE OF THOSE COSTS TOO LOW?

A. YES. ADDITIONAL COST INCREASES WILL RESULT FROM ADDED DESIGN TIME. DOE DID NOT CAREFULLY CONSIDER THE MAGNITUDE OR RANGE OF INCREASES RESULTING FORM DESIGNERS SPENDING FROM 10% TO 40% ADDITIONAL TIME ON THEIR PROJECTS. OTHER DOE COST ASSUMPTIONS ARE LOW, BY OUR ESTIMATES. THE ADDITIONAL FIRST COST FOR COMMERCIAL CONSTRUCTION WILL BE CLOSER TO 7%-9% HIGHER UNDER BEPS THAN NEW CONSTRUCTION TODAY. THIS IS NEARLY TWICE WHAT DOE ESTIMATES AS A MAXIMUM 5% INCREASE FOR COMMERCIAL CONSTRUCTION. RESIDENTIAL ESTIMATES OF $1.00/SQ.FT. INCREASES ARE SIMILARLY LOW. FROM OUR ASSESSMENT OF THE INFORMATION MADE AVAILABLE BY DOE, TANGENTIAL COSTS, PARTICULARLY IN MANUFACTURING AND DELIVERING MATERIALS IN

HIGHER DEMAND RESULTING FROM BEPS, WERE NEGLECTED IN THE ECONOMIC ASSESSMENT. MORE REALISTIC COST INCREASES FOR RESIDENTIAL CONSTRUCTION ARE $3.00/SQ.FT. OR 3 TIMES WHAT DOE HAS PREDICTED.

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Q. WILL THE FIRST COSTS OF NEW HOMES HEATED WITH ELECTRICITY GENERALLY EXCEED THE FIRST COSTS OF NEW HOMES USING OIL AND GAS?

A. ACEC EXPECTS GREATLY INCREASED COST FOR RESIDENTIAL CONSTRUCTION WHICH ATTEMPT TO INCORPORATE ELECTRIC RESISTANCE HEATING. REFERENCING THE STUDY PERFORMED BY THE NATIONAL ASSOCIATION OF HOME BUILDERS, NOT EVEN EXTRAORDINARY CONSERVATION MEASURES PERMITTED THE RESIDENCE STUDIED TO MEET THE BEPS ENERGY BUDGETS IN 4 OUT OF 5 CLIMATES. CONSTRUCTION COSTS FOR RESIDENCES IN THESE AREAS MAY INCREASE BY OVER 25%.

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Q. IS IT RATIONAL FOR DOE TO TOTALLY IGNORE A BUILDING'S ACTUAL ENERGY CONSUMPTION IN ESTABLISHING ENERGY BUDGET LEVELS?

A. NO. ACTUAL CONSUMPTION CANNOT BE IGNORED, PARTICULARLY IF THE CLIENT (OWNER) IS TO BE EXPECTED TO PAY INCREASED DESIGN FEES FOR ADDITIONAL CONSERVATION CHARACTERISTICS. DOE MUST MONITOR ACTUAL CONSUMPTION IF THEY INTEND TO MODIFY THE BUDGET LEVELS IN THE FUTURE.

Q. DOE CONSIDERED THE IMPACT OF CLIMATE ON ENERGY CONSUMPTION BY ESTABLISHING ENERGY BUDGET LEVELS FOR 78 DIFFERENT SMSA'S. DURING THE RESEARCH EFFORT, DOE ASSESSED THE IMPACT OF CLIMATE ON THE BASIS OF HEATING AND COOLING DEGREE-DAY TEMPERATURE IN SEVEN CLIMATE ZONES. DOE ABANDONED THE CLIMATE ZONE APPROACH AND THE TRADITIONAL TEMPERATURE BASE, HOWEVER, IN THE NOPR, EXPLAINING THAT THIS SHIFT MADE THE STATISTICAL ANALYSIS MORE RELEVANT. DOE HAS ALSO FOUND, THROUGH STUDIES, THAT SOLAR RADIATION AND HUMIDITY ARE NOT YARDSTICKS FOR ENERGY CONSUMPTION. DOE MADE NO MENTION OF THE IMPACT OF WIND. DOES THE SWITCH IN APPROACH DISTORT THE DOE ANALYSIS OF THE IMPACT OF CLIMATE ON ENERGY CONSUMPTION?

A. ACEC BELIEVES THAT THE CORRECT DECISION WAS MADE TO ABANDON THE ORIGINAL SEVEN CLIMATE ZONES. HOWEVER, THE EFFECT OF HUMIDITY, WIND VELOCITY, AND ATMOSPHERIC PRESSURE SHOULD HAVE BEEN STUDIED. THE BUDGET LEVELS FOR THE 78 DIFFERENT SMSA'S ARE BASED ON AN INCOMPLETE ANALYSIS AND MATHEMATICAL EXTRAPOLATION. YET DOE IS CONSISTENT WITH REGARD TO ITS DECISION TO IGNORE SUCH EFFECTS - WHICH MAY HAVE A CONSISTENTLY STABILIZING IMPACT ON THE BUDGET LEVELS SELECTED.

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Q. HAS DOE PERFORMED ANY STUDIES ON THE VALIDITY OF ESTABLISHING ENERGY BUDGET LEVELS USING SMSA'S?

A. NO. BUT FROM A STATISTICAL STANDPOINT, THIS APPROACH SEEMS VALID.

Q. WHAT LEVEL OF CONFIDENCE CAN BE PLACED IN DOE HEATING AND COOLING DEGREE-DAY REVISIONS WHICH HAVE NOT BEEN TESTED AGAINST ACTUAL CONDITIONS?

A. UNDETERMINED. WE ARE CONCERNED OF THEIR OVERLAP AND UNCERTAIN OF THEIR AFFECT ON ANNUAL ESTIMATES.

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Q. TO WHAT EXTENT IS TEMPERATURE DISPROPORTIONATELY EMPHASIZED OVER OTHER CLIMATIC FACTORS SUCH AS HUMIDITY, WIND, SOLAR GAIN/LOSS, CLOUD COVERAGE AND ATMOSPHERIC PRESSURE?

A. VIRTUALLY THE ENTIRE CLIMATE ANALYSIS WAS BASED UPON DEGREE-DAY (TEMPERATURE) VARIATIONS. HUMIDITY, WIND, SOLAR, AND ATMOSPHERIC PRESSURE WERE LARGELY IGNORED.

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Q. ARE SOLAR RADIATION FACTORS VARIABLE ENOUGH ON A SITE-BY-SITE BASIS TO INFLUENCE DESIGN ENERGY CONSUMPTION?

A. YES. SOLAR RADIATION IS HIGHLY VARIABLE AND HIGHLY SIGNIFICANT TOWARD PROPER UNDERSTANDING OF A BUILDING'S TOTAL THERMAL PERFORMANCE.

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Q. DOES WIND AFFECT ENERGY CONSUMPTION IN BUILDINGS?

A. YES. WIND DIRECTION AND VELOCITY ARE SIGNIFICANT FACTORS. WIND HITTING A BUILDING CREATES PRESSURE CHANGES BOTH INSIDE AND OUTSIDE THE BUILDING ENVELOP. SUCH PRESSURE CHANGES HAVE AN IMPACT ON THE INFILTRATION RATE, PRIMARILY AT DOORS AND WINDOWS. THE WIND SPEED ACROSS THE BUILDING SKIN INFLUENCES BUILDING SKIN TEMPERATURE, AFFECTING SOLAR GAIN, AND REDUCING THE TOTAL THERMAL RESISTANCE OF THE BUILDING ENVELOP. THESE FACTORS HAVE BEEN STUDIED SCIENTIFICALLY AND MANY AUTHORITATIVE RESOURCES ARE AVAILABLE TO SUPPORT THESE FACTS.

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Q. ARE THERE MARKED CLIMATIC DIFFERENCES BETWEEN CENTRAL URBAN LOCATIONS AND SUBURBAN LOCATIONS WITHIN THE SAME SMSA?

A. YES. AS WE HAVE ALL WITNESSED OVER THE YEARS, WINTER TEMPERATURE RANGES FOR WASHINGTON, D.C. DURING ANY GIVEN DAY WILL VARY AT DULLES AIRPORT AND WASHINGTON NATIONAL AIRPORT. SIMILARLY, URBAN AREAS ARE SUBJECT TO LIGHTER WINDS DUE TO THE MAN-MADE WIND BREAKS WE CALL BUILDINGS. THE ISSUES OF WIND AND TEMPERATURE IN SUCH INSTANCES ARE CLOSELY RELATED AND PROPORTIONALLY DEPENDENT CHARACTERISTICS. STILL WINDS PERMIT HIGHER TEMPERATURES. RAPIDLY MOVING WINDS CAUSE NOTICEABLE COOLING IN WINTER AND SUMMER.

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Q. WILL THERE BE ANOMALOUS AREAS WITHIN A SMSA, THAT IS, SPECIFIC AREAS WHERE CLIMATIC CONDITIONS VARY SUBSTANTIALLY FROM THE AVERAGE USED FOR THE AREAS?

A. YES, BUT SUCH AREAS SHOULD NOT HAVE AN ADVERSE IMPACT ON THE AMOUNT OF CONSTRUCTION ACTIVITY IN THE AREA. LARGE VARIATIONS SHOULD BE BROUGHT TO DOE'S ATTENTION FOR SPECIFIC REMEDY OR EXEMPTION.

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Q. WHAT EFFECT DOES DOE'S USE OF DEGREE-DAY BASES OF 60 DEGREES FOR HEATING AND 50 DEGREES FOR COOLING HAVE ON ENERGY BUDGET LEVELS?

A. THE HOURS BETWEEN 50 AND 60 ARE ALLOWED TO ADD TO HEATING ENERGY AS WELL AS COOLING ENERGY. THIS BEGS FOR A CONVINCING DEMONSTRATION. THESE FIGURES ARE NOT AVAILABLE TO DESIGNERS.

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Q. HAS THE RESEARCH PROGRAM SERVED TO ENSURE THAT THE STANDARDS FURTHER THE CONGRESSIONAL FINDINGS AND PURPOSES OF ECPA?

A. NO. THE RESEARCH EFFORT POSES MORE QUESTIONS ABOUT ENERGY CONSERVATION IN NEW BUILDINGS THAN IT RESOLVES.

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Q. HAS DOE MANIPULATED THE RESEARCH PROGRAM TO JUSTIFY PREDETERMINED RESULTS?

A. NOT LIKELY. ACEC BELIEVES THAT THE ORIGINAL RESEARCH EFFORT WAS OBJECTIVE AND NONPARTISAN.

Q. WHY DOES DOE FAIL TO IDENTIFY STUDIES, SUCH AS THOSE BY ARTHUR D. LITTLE, INC. AND BATTELLE, WHICH ANALYZE RUFS AND RIFS IN ITS DESCRIPTION OF THE RESEARCH EFFORT IN THE NOPR?

A. THE ORGANIZATIONS INVOLVED IN THE RESEARCH ARE NOT IMPORTANT TO THE ACTUAL RULEMAKING AND PUBLIC COMMENT PROCESS.

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Q. IN THE PHASE II RESEARCH, DOE SELECTED A SUBSAMPLE OF 168 BUILDINGS FOR REDESIGN FROM THE 1661 BUILDINGS IN THE PHASE I RESEARCH SURVEY. THE BUILDING CLASSIFICATION SYSTEM WAS REFINED TO INCLUDE 16 CATEGORIES. WAS THIS A REPRESENTATIVE SAMPLE?

A. FROM ACEC'S STANDPOINT, 168 BUILDINGS IS NOT A REPRESENTATIVE STATISTICAL SAMPLE.

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Q. HOW VALID ARE THE RESULTS?

A. ADDITIONAL RESEARCH WILL BE NEEDED TO VALIDATE THE RESULTS.

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Q. WHAT EFFECT DOES EXPANSION OF BUILDING CLASSIFICATION HAVE ON THE STATISTICAL VALIDITY OF THE RESULTS?

A. FURTHER EXPANSION OF THE BUILDING CLASSIFICATIONS WILL DILUTE THE RESEARCH RESULTS AND CAUSE SERIOUS DOUBT AS TO THE VALIDITY OF THE RESEARCH EFFORT.

Q. THE NOPR STATES THAT A STATISTICAL ANALYSIS WAS CONDUCTED TO RELATE THE SMALLER PHASE II SUBSAMPLE TO THE LARGER PHASE I SAMPLE IN ORDER TO ESTABLISH ESTIMATED ENERGY REQUIREMENTS FOR BOTH THE ORIGINAL AND REDESIGNED BUILDINGS. THESE RESULTS WERE FURTHER ADJUSTED BY THE RESULTS OF THE CLIMATIC ANALYSIS TO ESTABLISH ENERGY BUDGET LEVELS FOR EACH OF THE 16 BUILDING CLASSIFICATIONS IN 78 SMSA'S. WHAT IS THE LEVEL OF CONFIDENCE IN THE ESTIMATED ENERGY REQUIREMENTS AND THE ENERGY BUDGET LEVELS FOR THE VARIOUS BUILDING CLASSIFICATIONS?

A. VERY LOW WITHOUT FURTHER RESEARCH OF A BROADER SAMPLE TO VALIDATE THE ORIGINAL RESEARCH EFFORT.

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DOE PROJECTS THAT ENERGY SAVINGS FROM THE STANDARDS WILL BE THE EQUIVALENT OF 100,000 BARRELS OF OIL PER DAY BY 1985 AND 216,000 BARRELS PER DAY BY 1990. IN 1976 CONGRESS ESTIMATED THAT FROM 6 TO 12.5 MILLION BARRELS (EQUIVALENT) COULD BE SAVED UNDER THE BEPS PROGRAM. THE DOE PROJECTIONS ARE LESS THAN 4% OF THE CONGRESSIONAL ESTIMATES. ACEC IS CONCERNED ABOUT THE OVERLY ZEALOUS CONGRESSIONAL PROJECTIONS. IF THE DOE ESTIMATES ARE ACCURATE, WE WOULD APPRECIATE KNOWING THE FOLLOWING:

A. WHAT ARE THE BASES FOR THE DOE ESTIMATES?
B. WHAT WILL THE ACTUAL SAVINGS BE FOR BOTH IMPORTED AND DOMESTIC NATURAL GAS?

C. WHAT WILL THE ACTUAL SAVINGS BE IN TERMS OF BARRELS OF OIL, BOTH IMPORTED AND DOMESTIC?

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Q. DOE ESTIMATES ENERGY SAVINGS FROM THE STANDARDS OF .22 QUADS ANNUALLY BY 1985, .46 QUADS ANNUALLY BY 1990, AND A CUMULATIVE ENERGY SAVINGS BETWEEN 1980 AND 2020 OF 29 QUADS. IT FURTHER STATES THAT THESE ESTIMATED SAVINGS ARE IN ADDITION TO ENERGY SAVED BY OTHER ENERGY-EFFICIENCY IMPROVEMENT STANDARDS. WHAT IS THE LEVEL OF CONFIDENCE IN THESE ESTIMATES?

A. EXTEMELY LOW BECAUSE NO BASIS IS OFFERED FOR SUCH ESTIMATES. IT IS NOT POSSIBLE FOR ACEC TO ASSESS THE LOGIC OR THE ACCURACY OF DOE'S CLAIM.

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Q. IS DOE'S FINDING THAT THE PROPOSED STANDARDS WILL REQUIRE NEW BUILDINGS TO REDUCE THEIR DESIGN ENERGY REQUIREMENTS BY 17% TO 52% FROM THEIR 1975-1976 LEVELS ACCURATE.

A. ACCORDING TO THE INFORMATION WE HAVE SEEN, THIS ESTIMATE IS ACCURATE.

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Q. DOE ESTIMATES AN INCREASE IN THE COST OF CONSTRUCTION OF 3-5% ABOVE A 1978 BASE FOR COMMERCIAL BUILDINGS, AND OF $.75 TO $1 PER SQUARE FOOT ABOVE A 1978 BASE FOR RESIDENTIAL BUILDINGS. WHAT ARE THE BASES OF THESE ESTIMATES?

A. THE BASES APPEAR TO BE VALID BUT INCOMPLETE. DOE HAS PROJECTED FIRST COST INCREASES PRIMARILY ON ADDED COSTS FROM INCREASING BUILDING INSULATION, REDUCING WINDOW AREA AND USING 3-GLAZED WINDOW UNITS, HIGHER EFFICIENCY APPLIANCES AND CONTROLLED INFILTRATION. THIS MUCH OF THE JUSTIFICATION IS VALID. HOWEVER, NO INCREASES ARE INCLUDED FOR DESIGN TIME, CODE COMPLIANCE, MANUFACTURING PROBLEMS, RE-TOOLING FOR SMALLER HEATING UNITS AND OTHERS. LABOR CONDITIONS ARE EVALUATED BASED UPON SHIFTS FROM ELECTRICAL TRADES TO INSULATION TRADES AND OTHER MATERIALS MANUFACTURING INDUSTRIES. NO CONSIDERATION IS GIVEN TO THE COST OF ADDITIONAL LABOR ON THE SITE FOR HANDLING LARGER QUANTITIES OF INSULATION, LUMBER, AND GLASS MATERIALS. THESE FACTORS COMBINED WITH THOSE PREVIOUSLY MENTIONED GIVE US REASON TO BELIEVE THAT DOE'S ESTIMATES ARE AT LEAST 100% LOW.

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Q. DOE REQUIRES THE USE OF THE DOE-2 COMPUTER PROGRAM TO CALCULATE DESIGN ENERGY REQUIREMENTS OF NON-SOLAR SINGLE-FAMILY RESIDENTIAL BUILDINGS AND COMMERCIAL BUILDINGS WITH CENTRAL SYSTEMS. HAVE THE DOE-2 RESULTS BEEN TESTED AND VERIFIED?

A. ON PAPER THE DOE-2 RESULTS SEEM VALID. HOWEVER, TO OUR KNOWLEDGE NO BUILDINGS HAVE BEEN BUILT TO VERIFY THAT THE DOE-2 CALCULATIONS RESEMBLE THE ACTUAL ENERGY PERFORMANCE.

Q. IS THE DOE-2 COMPUTER PROGRAM EASILY USABLE?

A. NO. THE DOE-2 PROGRAM IS COMPLEX AND CONFUSING. TODAY, MOST FIRMS ARE UNABLE TO JUSTIFY THE COST OF COMPUTERS, LET ALONE TO ACTUALLY PURCHASE AND INSTALL THE COMPUTER EQUIPMENT. IF COMPUTER SIMULATIONS ARE NECESSARY, IT WILL BE ESSENTIAL TO SIMPLIFY THE PROGRAM TO WHERE THE HARDWARE, SOFTWARE, AND MANPOWER IS REASONABLY AFFORDABLE FOR DESIGN FIRMS.

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Q. HOW MANY DESIGNERS ARE CAPABLE OF USING THE PROGRAM?

A. VIRTUALLY NONE. AS PROPOSED A DESIGNER WOULD BE REQUIRED TO HIRE A COMPUTER SPECIALIST AS A CONSULTANT TO PROVIDE THE NECESSARY COMPUTER SIMULATIONS. AT PRESENT ONLY ONE IN FIVE DESIGNERS CAN ACCESS THE PROGRAM, AND IT IS NOT YET FINISHED.

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Q. WHAT DOES IT COST TO PREPARE INPUT FORMS?

A. DEPENDING UPON THE BUILDING TYPE, ITS COMPLEXITY, AND ITS LOCATION, PREPARATION TIME WILL RANGE FROM 50 TO 300 HOURS. AT $20.00/HR. IN THE EXTREME CASE, THE COSTS COULD RUN AS HIGH AS $6,000.00 PER COMPUTER RUN.

Q. WHAT IS THE COST OF COMPUTER TIME?

A. THIS RANGES FROM $30/HR. TO $300/HR. DEPENDING UPON THE TIME OF DAY.

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Q. WHAT ARE THE LIMITATIONS OF THE DOE-2 PROGRAM?

A. AS WITH NEARLY ALL COMPUTERS, IT IS NOT PRACTICAL TO CONSIDER THE COMPUTER A "DESIGN TOOL". THE ACTUAL INFORMATION WHICH IS PROGRAMMED INTO THE COMPUTER IS BASED UPON DESIGN DECISIONS ALREADY MADE. THE BUILDING DESIGN MUST BE APPROXIMATELY 75% COMPLETE BEFORE THE COMPUTER IS USEFUL TO DETERMINE THE ESTIMATED ENERGY CONSUMPTION. IF AT 75% COMPLETION THE COMPUTER INDICATES THAT THE BUILDING WILL NOT MEET THE PRESCRIBED BUDGETS, THEN THE DESIGNER MUST BACK TRACK AND CHANGE THE DESIGN. THIS REQUIRES ADDITIONAL TIME AND IS ENORMOUSLY EXPENSIVE.

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Q. THE MID-TERM FORECASTS OF NATIONAL AVERAGE PRICES FOR OIL, GAS, COAL AND ELECTRICITY DEVELOPED BY DOE AND PUBLISHED IN THE FEDERAL REGISTER (APR. 30, 1977) WERE USED IN CALCULATING WEIGHTING FACTORS. IS IT POSSIBLE TO FORECAST FUEL PRICES WITH ANY REASONABLE DEGREE OF CERTAINTY?

A. NO. HOWEVER, ACEC UNDERSTANDS THAT DOE IS REVISING ITS FUEL PRICING FORECAST ON THE BASIS OF 1979 AVERAGE PRICES. THIS COM-

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BINED WITH RESEARCH RESULTS ON MARGINAL COSTS SHOULD PROVIDE PROJECTIONS WHICH ARE ACCEPTABLE.

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Q. WHAT PROVISIONS ARE THERE FOR UPDATING THE FORECASTS?

A. AS PROPOSED THERE ARE NO PROVISIONS FOR UPDATING THE FORECASTS. ACEC BELIEVES THAT A SYSTEM OF MONITORING AND UPDATING PRICING FORECASTS ON AN ANNUAL BASIS SHOULD COINCIDE WITH A PROGRAM OF MONITORING COMPLIANCE WITH THE BEPS.

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Q. ARE THE CLASSIFICATIONS FOR COMMERCIAL AND MULTI-FAMILY BUILDINGS SET OUT IN THE NOPR VALID?

A. THE PROPOSED CLASSIFICATIONS SEEM ADEQUATE.

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Q. HOW WILL BUILDING DESIGNS THAT CLEARLY DO NOT FIT WITHIN ANY SINGLE CLASSIFICATION BE TREATED?

A. SOME INTERPRETATIONS WILL BE NECESSARY TO ASSIGN A CLASSIFICATION TO MULTI-USE OR NON-CONFORMING BUILDINGS.

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Q. SHOULD ADDITIONAL PROTOTYPES HAVE BEEN INCLUDED IN THE PROPOSED RULE (E.G., RESIDENCES WITH HEATED BASEMENTS AND RESIDENCES BOUNDED ONLY ON ONE SIDE)?

A. YES. THIS LIMITATION STEMS FROM THE SMALL ORIGINAL RESEARCH SAMPLE. ADDITIONAL RESIDENTIAL PROTOTYPES SHOULD HAVE BEEN STUDIED AND FURTHER RESEARCH IN THIS AREA IS DRASTICALLY NEEDED.

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Q. DO THE BUILDING DESIGN CLASSIFICATIONS SELECTED BY DOE REFLECT THE VARYING ENERGY REQUIREMENTS OF BUILDINGS DESIGNED TO FULFILL DIFFERENT FUNCTIONS?

A. NO. THIS IS NOT POSSIBLE. EVERY BUILDING IS DESIGNED TO MEET A SPECIFIC AND UNIQUE SET OF FUNCTIONAL REQUIREMENTS. ONLY GENERAL CLASSIFICATIONS, SUCH AS THOSE PROPOSED, ARE REASONABLE.

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Q. WILL PASSIVE AND ACTIVE SOLAR ENERGY SYSTEMS PROVIDE A VIABLE OPTION FOR MEETING THE DESIGN ENERGY BUDGETS FOR SINGLE-FAMILY RESIDENTIAL BUILDINGS, OR WILL DESIGNERS SIMPLY CHOOSE OIL AND GAS ENERGY SYSTEMS RATHER THAN PASSIVE AND ACTIVE SOLAR ENERGY SYSTEMS?

A. YES. WE BELIEVE THAT DESIGNERS WILL BE FORCED TO CONSIDER THE USE OF SOLAR TECHNOLOGIES IN ORDER TO MORE EASILY MEET THE REQUIREMENTS OF THE STANDARDS.

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Q. IS HYDRO-ELECTRIC POWER NONDEPLETABLE?

A. IN OUR OPINION YES.

Q. WHAT IMPACT WILL THE APPLICATION OF SOLAR ENERGY SYSTEMS HAVE ON THE USE OF ELECTRIC SPACE HEATING SYSTEMS, AND, IN TURN, WHAT WILL BE THE IMPACT ON ELECTRICAL DEMAND?

A. IF THE PROPOSED "CREDITS" FOR SOLAR ENERGY SYSTEMS ARE RETAINED, DESIGNERS WILL BE FORCED TO ACTUALLY UTILIZE SUCH SYSTEMS AS TRADE-OFFS TO PERMIT ELECTRIC SPACE HEATING. AS YET, THE MAGNITUDE OF THESE TRADE-OFFS IS UNKNOWN. IN ANY CASE, THE DEMAND FOR RESISTANCE HEATING WILL DECLINE AT A RATE INVERSELY PROPORTIONAL TO THE USE OF SOLAR ENERGY SYSTEMS.

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Q. WILL BEPS ENCOURAGE LARGE SCALE SOLAR-POWERED ELECTRIC GENERATION?

A. NO.

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Q. WHAT EFFECT WILL THE STANDARDS HAVE ON SHIPMENTS OF RESIDENTIAL HEAT PUMPS?

A. THEY WILL DECLINE.

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Q. TO DATE DOE HAS PREPARED BOTH A DRAFT ECONOMIC IMPACT STATEMENT AND A DRAFT REGULATORY ANALYSIS. BOTH STUDIES EXAMINE THE LIKELY ECONOMIC IMPACTS OF BEPS UPON THE NATION AS A WHOLE, THE CONSTRUCTION INDUSTRY, AND THE BUILDING OWNER/ OCCUPANTS. THE ANALYSES

USE THE MEANS OF THE AUGUST 1978 REDESIGNS AS GUIDEPOSTS TO PREDICT THE DIRECTION OF BUILDING CONSTRUCTION, ASSUMING THE IMPLEMENTATION OF THE STANDARDS UNIFORMLY THROUGHOUT THE COUNTRY. HAS DOE SUFFICIENTLY ANALYZED THE PRIMARY NATIONAL IMPACTS, INCLUDING THE EFFECT ON DOMESTIC PRODUCTION, INVESTMENT, INFLATION, TRADE BALANCES AND EMPLOYMENT?

A. DOE HAS PRODUCED GOOD INFORMATION CONCERNING NATIONAL ECONOMIC IMPACTS. HOWEVER, THE ASSUMPTIONS MADE EARLY IN THE RESEARCH CONCERNING LABOR, INFLATION, OIL IMPORTS AND TRADE BALANCES ARE QUESTIONABLE. WE BELIEVE THAT INADEQUATE INFORMATION HAS BEEN REVIEWED BY DOE IN THE AREA OF THE BEPS AFFECT ON DOMESTIC PRODUCTION. THIS BELIEF STEMS FROM THE FACT THAT INADEQUATE JUSTIFICATION FOR WEIGHTING FACTORS APPEAR IN THE DRAFT ECONOMIC IMPACT STATEMENT. WE DO NOT BELIEVE THE DOE'S TASK HAS BEEN COMPLETED - TO THOROUGHLY ANALYZE ECONOMIC IMPACTS ON THE DESIGN AND CONSTRUCTION INDUSTRY. AS DOE HAS SO OFTEN STATED, THE BEPS ARE "DESIGN STANDARDS". THEREFORE, IT WOULD FOLLOW THAT THE IMPACT OF THE STANDARDS ON THE "DESIGN PROFESSIONS" WOULD HAVE BEEN EXPLORED IN DETAIL. THIS DID NOT OCCUR AND IS NOT DISCUSSED IN THE ECONOMIC IMPACT STATEMENT.

Q. THE NOPR PROVIDES TWO APPROACHES FOR DETERMINING COMPLIANCE WITH THE STANDARDS -- A PERFORMANCE APPROACH AND AN EQUIVALENCY APPROACH (THAT HAS NOT YET BEEN ESTABLISHED). THE PERFORMANCE APPROACH INCORPORATES THE STANDARD EVALUATION TECHNIQUE THAT USES THE DOE-2 COMPUTER PROGRAM (OR ANY ALTERNATIVE APPROACH APPROVED BY DOE). SHOULD THE ALTERNATIVES BE DEFINED BEFORE A FINAL RULE IS PROMULGATED?

A. YES. IF A MANUAL OF ACCEPTABLE PRACTICES IS DEVELOPED BY DOE AS AN ALTERNATIVE TO COMPUTER SIMULATIONS, THE PUBLIC - PARTICULARLY ENGINEERS AND ARCHITECTS - SHOULD BE PERMITTED AN OPPORTUNITY TO REVIEW, COMMENT ON, AND RECOMMEND CHANGES PRIOR TO THE ISSUANCE OF THE MANUAL AS AN APPENDIX TO THE FINAL RULE.

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Q. SHOULD THE ALTERNATIVES BE TESTED BEFORE A FINAL RULE IS PROMULAGED?

A. YES. AT THE VERY LEAST, AN INDEPENDENT AND OBJECTIVE EVALUATION OF THE PROPOSED ALTERNATIVES, PREFERABLY THROUGH CASE STUDIES OR DETAILED MANUAL CALCULATIONS, SHOULD BE CONDUCTED.

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Q. IN LIGHT OF THE LIMITED PRACTICAL EXPERIENCE IN DETERMINING THE EQUIVALENCY BETWEEEN ENERGY CALCULATION METHODS, IS IT LIKELY THAT DOE WILL EVER BE ABLE TO APPROVE ALTERNATE METHODS?

A. IT IS LIKELY THAT DOE WILL NEED ADDITIONAL STAFF AND ADDITIONAL

RESOURCES TO EFFECTIVELY EVALUATE AND APPROVE ALTERNATIVE METHODS. UNTIL THEN WE DO NOT ANTICIPATE DOE ASSUMING THIS ROLE WITH ANY PROFICIENCY.

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Q. WHAT PROCEDURES WILL DOE USE TO APPROVE ALTERNATE TECHNIQUES?

A. WE DO NOT KNOW, BUT WE WOULD HOPE TO SEE DOE DEVELOP AND USE A VERY SIMPLE EVALUATION PATH.

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Q. IS IT APPROPRIATE FOR DOE TO REQUIRE USE OF A COMPUTER PROGRAM IN THE STANDARD EVALUATION TECHNIQUE?

A. ACEC BELIEVES THAT WHILE DOE MAY RECOMMEND THE USE OF COMPUTERS, THE REQUIRED USE OF A SPECIFIC COMPUTER PROGRAM IS INAPPROPRIATE AND BEYOND THE AUTHORITY GIVEN DOE BY THE CONGRESS.

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Q. IS THE STANDARD EVALUATION TECHNIQUE TOO COMPLICATED FOR NON-COMPUTER EXPERTS TO USE?

A. YES.

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Q. WILL IT EVER BE POSSIBLE TO DEVELOP ANY "MANUAL" FOR ENERGY CALCULATION METHODOLOGIES?

A. YES.

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Q. DOE HOPES TO EXPAND THE STANDARD EVALUATION TECHNIQUE FOR THE FINAL RULE TO ENCOMPASS ALL BUILDING AND GENERIC HVAC SYSTEM CATEGORIES. IS SUCH A RESULT FEASIBLE?

A. DOE MAY BE ABLE TO GENERICALLY CATEGORIZE EXISTING HVAC SYSTEMS FOR USE IN THE STANDARD EVALUATION TECHNIQUE. HOWEVER, IT IS NOT FEASIBLE TO ENCOMPASS ALL SUCH BUILDING SYSTEMS AS EVERY BUILDING IS UNIQUE AND TAKES ADVANTAGE OF DIFFERING COMBINATIONS OF SYSTEMS AND COMPONENTS.

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Q. WILL DOE SUBMIT SUCH AN EXPANDED TECHNIQUE TO THE PUBLIC PRIOR TO ITS INCORPORATION IN THE FINAL RULE?

A. ACEC WOULD HOPE TO REVIEW AND COMMENT ON AN EXPANDED TECHNIQUE PRIOR TO ITS INCORPORATION IN THE FINAL RULE.

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Q. THE PROCEDURE FOR DETERMINING COMPLIANCE WITH THE DESIGN ENERGY BUDGETS CAN LEAD TO SEVERAL DESIGN REVISIONS BY THE ARCHITECT OR ENGINEER. DOE RECOGNIZES THAT THE "PRUDENT DESIGNER" WOULD BE UNLIKELY TO PROCEED ON THAT BASIS, BUT WOULD PREFER TO KNOW, IN GENERAL, THE DESIGN ENERGY BUDGET TARGET AT THE OUTSET OF THE DESIGN PROCESS. THE NOPR SUGGESTS THAT A DESIGNER COULD DERIVE A "PRELIMINARY ESTIMATE" OF THE BUDGET FROM DESIGN INFORMATION

GENERALLY KNOWN AT THE OUTSET OF THE DESIGN PROCESS. THIS PRELIMINARY ESTIMATE COULD THEN BE USED AS A GUIDE FOR DESIGN DECISIONS. IS THIS SUGGESTION A WORKABLE SHORTHAND METHOD OF PREDETERMINING COMPLIANCE WITH THE DESIGN ENERGY BUDGET?

A. NO. IT IS A FACT THAT PRELIMINARY ESTIMATES OFTEN BEAR NO RELATIONSHIP WHATSOEVER TO THE ULTIMATE PRODUCT DUE TO CHANGES WHICH OCCUR IN PROJECT SCOPE, COST CONSIDERATIONS AND SCHEDULE. COMPLIANCE, AS WE INTERPRET THE TERM, CANNOT BE EVIDENCED UNTIL THE ACTUAL CALCULATIONS HAVE BEEN COMPLETED. AS STATED EARLIER, THE DESIGN NEEDS TO REACH APPROXIMATELY 75% COMPLETION PRIOR TO USING THE COMPUTER TO CHECK THE DECISIONS. WITH TIME AND EXPERIENCE, DESIGNERS MAY BECOME KNOWLEDGEABLE ENOUGH TO CLOSELY PREDICT COMPLIANCE EARLY ON IN THE PROCESS. HOWEVER, SUCH EXPERTISE MAY TAKE MANY YEARS TO DEVELOP.

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Q. THE AMOUNT OF ENERGY ACTUALLY CONSUMED IN A BUILDING DEPENDS SUBSTANTIALLY UPON HOW A BUILDING IS USED AND HOW ITS ENERGIZED SYSTEMS OPERATE. TO PROVIDE "CONSISTENCY IN EVALUATING BUILDING PERFORMANCE," HOWEVER, DOE HAS SPECIFIED THAT STANDARD BUILDING OPERATING CONDITIONS ARE TO BE USED IN CALCULATING ENERGY CONSUMPTION FOR PURPOSES OF BEPS COMPLIANCE. THESE OPERATING CONDITIONS ARE BASED ON A NUMBER OF ASSUMPTIONS. IS THE DEVELOPMENT OF A SET OF FIXED PARAMETERS FOR BUILDING OPERATIONS AN ACCEPTABLE METHODOLOGY FOR USE IN CALCULATING DESIGN ENERGY CONSUMPTION?

A. YES. ALTHOUGH THE ACCURACY OF ANY CONCLUSIONS DRAWN USING FIXED PARAMETERS IS CHALLENGABLE, SUCH FIXED PARAMETERS ARE

NECESSARY TO ESTIMATE DESIGN ENERGY CONSUMPTION.

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Q. WILL IT BE NECESSARY TO PERFORM ADDITIONAL COMPUTER RUNS IN ORDER TO ESTIMATE ACTUAL ENERGY CONSUMPTION?

A. IT MAY BE NECESSARY TO RUN SEVERAL ITERATIONS OF ESSENTIALLY THE SAME DATA TO DETERMINE THE MOST ACCURATE ESTIMATE OF ACTUAL ENERGY CONSUMPTION.

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Q. ARE THE STANDARD BUILDING OPERATING CONDITIONS PROVIDED FOR EACH BUILDING CLASSIFICATION REASONABLE?

A. SOME OF THE OCCUPANCY PROFILES ARE QUESTIONABLE. HOSPITALS, FOR EXAMPLE, OPERATE 24 HOURS A DAY AT NEAR 100% DESIGN ENERGY DEMAND. SOME SCHOOLS, DEPENDING UPON A BROAD RANGE OF VARIABLES MAY ONLY OPERATE DURING WORKING HOURS. YET, OTHER SCHOOLS ARE SUBJECT TO EVENING USE FOR SOCIAL EVENTS AND COMMUNITY SERVICE FUNCTIONS. OCCUPANCY USE PROFILES AND OTHER ASPECTS OF THE PROPOSED STANDARD BUILDING OPERATING CONDITIONS ARE HIGHLY SPECULATIVE AND NOT "STANDARD" IN THE LEAST.

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Q. WHEN PROPERLY APPLIED IN APPROPRIATE CLIMATES, DECENTRALIZED ELECTRIC RESISTANCE HEATING CAN BE EXTREMELY ENERGY EFFICIENT, ESPECIALLY WHEN USED IN CONJUNCTION WITH ADVANCED CONTROL TECHNOLOGY THAT IS COMMERCIALLY AVAILABLE. THIS EFFICIENCY RESULTS FROM

SELECTIVITY IN OPERATION AND FROM ZONAL ASPECTS OF THE SYSTEM. USE OF THE STANDARD BUILDING OPERATING CONDITIONS, HOWEVER, PROHIBITS THE CONSIDERATION OF THE USE OF SUCH SYSTEMS. WILL RESTRICTIONS ON THE USE OF DECENTRALIZED ELECTRIC RESISTANCE HEATING INCREASE INITIAL CONSTRUCTION COSTS?

A. POSSIBLY. THE ONLY CERTAINTY IS THAT THE CHOICE OF HEATING SYSTEMS WILL BE FURTHER LIMITED. SUCH A LIMITATION COULD FORCE THE SELECTION OF A MORE COSTLY CENTRAL HEATING SYSTEM.

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Q. WILL THIS APPROACH PLACE A FINANCIAL HARDSHIP UPON MANUFACTURERS, DISTRIBUTORS AND INSTALLERS OF DECENTRALIZED ELECTRIC RESISTANCE HEATING SYSTEMS?

A. YES. AS THE ECONOMIC IMPACT STATEMENT SUGGESTS, LABOR SHIFTS WILL OCCUR RESULTING FROM A DECLINE IN THE USE OF ELECTRIC RESISTANCE HEATING. IT IS UNCERTAIN THAT SUFFICIENT NEW EMPLOYMENT OPPORTUNITIES WILL BE CREATED TO ABSORB WORKERS LAYED-OFF WITHIN THE ELECTRICAL INDUSTRY.

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Q. IN CALCULATING HEATING AND COOLING DESIGN ENERGY BUDGETS FOR SINGLE-FAMILY RESIDENTIAL BUILDINGS, DOE ASSUMED 0.6 AIR CHANGES PER HOUR. ZEALOUS USE OF WEATHERSTRIPPING, ETC., COULD FEASIBLY REDUCE THIS RATE TO 0.1 AIR CHANGES PER HOUR IN MILD CLIMATES AND 0.2 AIR CHANGES PER HOUR IN COLDER ONES. IS A 0.6 AIR CHANGE RATE SUFFICIENT TO MAINTAIN HEALTHY AIR QUALITY?

A. UNKNOWN. RESEARCH NOW UNDERWAY MAY INDICATE THAT .6 AIR CHANGE/ HR. IS SUFFICIENT.

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Q. IS A 0.1 OR 0.2 AIR CHANGE RATE ADEQUATE TO MAINTAIN HEALTHY AIR QUALITY?

A. NOT LIKELY. FURTHER RESEARCH IS NEEDED TO DETERMINE IF INCREASED COMBINATIONS OF RADON GAS, UREA FORMALDIHYED, AND CARBON DIOXIDE IS HARMFUL IN LARGER QUANTITIES. AT SUCH LOW AIR CHANGE RATES, THE POSSIBILITY OF AIR STAGNATION IS GREATLY INCREASED.

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Q. SHOULD THE RELATIONSHIP BETWEEN HEALTHY INDOOR AIR QUALITY AND INFILTRATION RATES BE ANALYZED MORE CLOSELY BEFORE FINAL RULES ARE PROMULGATED?

A. ABSOLUTELY.

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Q. THE STANDARDS AS PROPOSED GIVE NO CREDIT FOR REDUCED RATES OF AIR INFILTRATION BELOW 0.6. DOE THUS EXPECTS THAT BEPS WILL NOT REDUCE VENTILATION RATES, WILL NOT AFFECT INDOOR QUALITY AND WILL NOT, THEREFORE, NECESSITATE ANY CHANGES IN LOCAL HEALTH CODES. IS IT REASONABLE TO ASSUME THAT BEPS WILL NOT ENCOURAGE REDUCED VENTILATION REQUIREMENTS IN LOCAL HEALTH CODES?

A. NO. REDUCING VENTILATION RATES REDUCES ENERGY DEMAND. THERE-

FORE, A LOGICAL CONCLUSION IS THAT A PERFORMANCE STANDARD SUCH AS THIS WOULD ENCOURAGE LOWER VENTILATION RATES.

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Q. SHOULD A COMPREHENSIVE STUDY OF ALL LOCAL HEALTH CODES IN THE U.S. BE PERFORMED TO DETERMINE THOSE CODES' IMPACT ON BUILDING ENERGY CONSUMPTION?

A. YES.

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Q. SHOULD A BUILDING'S ENERGY BUDGET BE ADJUSTABLE UPWARD OR DOWNWARD DEPENDING ON LOCAL HEALTH CODE VENTILATION REQUIREMENTS?

A. ACEC BELIEVES THAT THE ENERGY BUDGET LEVELS SHOULD BE FLEXIBLE ENOUGH TO PERMIT COMPLIANCE WITH EXISTING LOCAL HEALTH CODE VENTILATION REQUIREMENTS.

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Q. SHOULD DOE HAVE CONSIDERED REDUCED INFILTRATION RATES IN ESTABLISHING ENERGY BUDGET LEVELS?

A. YES. IF RESEARCH INDICATES THAT REDUCED INFILTRATION RATES DO NOT ADVERSELY AFFECT AIR QUALITY TO THE POINT OF BEING HAZARDOUS FOR INHABITANTS, THEN DOE SHOULD ALLOW A "CREDIT" FOR ACHIEVING LOWER RATES. SUCH A CREDIT COULD BE TREATED SIMILARLY TO THE PROPOSED TREATMENT OF SOLAR AND DAY LIGHTING CREDIT PROPOSALS.

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Q. THE NOPR STATES THAT DOE TESTED THE EQUIVALENCY OF OTHER STANDARDS TO BEPS. IN ONE INSTANCE, DOE ANALYZED ASHRAE STANDARD 90, AFTER CHANGING IT TO MAKE IT MORE STRINGENT. USING A SAMPLE OF TWO BUILDING TYPES (SMALL OFFICE BUILDINGS AND WAREHOUSES), DOE FOUND THAT THE RESULTS WERE WITHIN 2% OF THOSE FROM BEPS. ACEC HAS STUDIED THE EVALUATION OF STANDARD 90 AND WE GENERALLY AGREE WITH THE CONCLUSIONS DRAWN. THE STUDY CAUSES US TO WONDER IF THE CHANGES WOULD HAVE A SIMILAR EFFECT IF APPLIED TO BUILDING TYPES OTHER THAN THE SMALL OFFICES AND COMMERCIAL FACILITIES USED IN THE ANALYSIS. WOULD THOSE CHANGES HAVE BEEN AS EFFECTIVE IF ASHRAE STANDARD 90 HAD BEEN APPLIED TO OTHER BUILDING TYPES?

A. BASED UPON THE "PRUDENT RETROFIT" APPROACH, ACEC BELIEVES THAT ASHRAE STANDARD 90 WOULD PRODUCE SIMILAR RESULTS ON NEARLY ALL BUILDING TYPES. WE SUSPECT THAT VERY LARGE COMMERCIAL OFFICE BUILDINGS COULD BE DESIGNED USING A PRUDENT ASHRAE APPROACH AND ACHIEVE RESULTS EQUAL TO OR LOWER THAN THE BEPS ENERGY BUDGETS. ACEC RECOMMENDS ADDITIONAL ANALYSIS OF THE APPLICABILITY OF THE PRUDENT ASHRAE STANDARD 90 TO OTHER BUILDING TYPES.

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Q. HAS ASHRAE STANDARD 90 ACTUALLY BEEN ADOPTED IN ANY JURISDICTIONS? IF SO, WHAT HAS ITS ACTUAL IMPACT BEEN?

A. YES. OVER 40 STATE BUILDING CODES ARE MODELED AFTER THE ASHRAE STANDARD. DUE TO THE FACT THAT THE STANDARD WAS NOT PUBLISHED AND MADE AVAILABLE UNTIL 1975, MOST STATES HAVE VERY FEW BUILDINGS

WHICH HAVE BEEN CONSTRUCTED WITH THESE ENERGY CONSERVING CHARACTERISTICS. THIS PROBLEM EXISTS BY VIRTUE OF THE TIME REQUIRED TO ENACT STATE LEGISLATION, EDUCATE LOCAL CODE OFFICIALS AND/OR MODIFY LOCAL CODES, AND DESIGN THE BUILDING. TWO OR THREE YEARS IS NOT AN ADEQUATE MEASURE OF THE EFFECTIVENESS OF A BUILDING STANDARD.

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Q. DOE HAS ALSO INDICATED THAT BUILDING CODES MAY BE EVALUATED FOR EQUIVALENCY. IF FOUND EQUIVALENT, COMPLIANCE WITH THEM WOULD BE DEEMED COMPLIANCE WITH BEPS. WILL PERMITTING COMPLIANCE WITH BEPS THROUGH THE USE OF AN APPROVED BUILDING CODE IMPOSE, IN EFFECT, A PRESCRIPTIVE STANDARD ON BUILDINGS SUBJECT TO THAT CODE?

A. THIS IS A VERY COMPLICATED QUESTION. THE BEPS PROCESS IS EXTREMELY COMPLEX AND THE PROPOSED ALTERNATIVES TO A STANDARD EVALUATION TECHNIQUE (I.E., A MANUAL OF ACCEPTED PRACTICES) HAVE A TENDENCY TO PRESCRIBE ACCEPTABLE COMBINATIONS OF BUILDING COMPONENTS. THE ESTABLISHMENT OF ENERGY BUDGET LEVELS IS CERTAINLY A PRESCRIPTIVE TACTIC. ALL THINGS CONSIDERED, THE ENACTMENT OF THE BEPS COMES VERY CLOSE TO BEING A PRESCRIPTIVE RATHER THAN A PERFORMANCE APPROACH TO REDUCING ENERGY CONSUMPTION.

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Q. DOE ASSERTS THAT THE UNFAMILIARITY OF DESIGN PROFESSIONALS WITH ENERGY-EFFICIENT DESIGN STRATEGIES AND AVAILABLE TECHNOLOGY IS ACTUALLY THE MAJOR CONSTRAINT IN THE DESIGN OF MORE ENERGY-EFFICIENT COMMERCIAL AND MULTI-FAMILY BUILDINGS. IS THIS TRUE?

A. IT IS MORE HABIT THAN LACK OF FAMILIARITY. A MONUMENTAL EDUCATIONAL EFFORT IS NEEDED TO TEACH DESIGNERS MORE ABOUT AVAILABLE TECHNOLOGY AND SPECIFIC TECHNIQUES FOR CONSERVING ENERGY.

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Q. WILL THE COMPLEXITY OF BEPS MAKE IT UNFEASIBLE FOR A PERSON EVER TO BUILD HIS OWN NEW HOME?

A. NO. HOWEVER, A LARGE SEGMENT OF POTENTIAL NEW HOME BUILDERS WILL BE FACED WITH A DECISION TO BUILD A MORE EXPENSIVE, ENERGY EFFICIENT HOME OR TO PURCHASE A LESS EXPENSIVE, LESS ENERGY EFFICIENT HOME. THIS DECISION COMPOUNDED BY HIGH INTEREST RATES COULD CAUSE MOST POTENTIAL HOME BUILDERS TO BECOME PURCHASERS OF EXISTING HOUSING STOCK.

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Q. WHAT IS THE EFFECT OF DOE'S FAILURE TO HAVE COMPLETED THE NECESSARY RESEARCH IN ORDER TO PROPOSE A MOBILE HOME ENERGY PERFORMANCE STANDARD?

A. UNDETERMINED. THE LAW CLEARLY STATES THAT BEPS WILL BE DEVELOPED FOR ALL NEW BUILDINGS. DOE SHOULD HAVE COMPLETED THE RESEARCH AND INCLUDED MOBILE HOMES IN THE NOVEMBER 28, 1979, FEDERAL REGISTER RELEASE.

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Q. SHOULD THE STANDARDS BE UPDATED EVERY 3-5 YEARS OR SHOULD PREDETERMINED LONG-TERM BUDGET LEVELS OF 10 YEARS OR MORE BE SET?

A. BEPS SHOULD BE CONSTANTLY MONITORED AND UPDATED AT LEAST EVERY 3-5 YEARS. ACEC ANTICIPATES THAT MORE FREQUENT UPDATES OF BUDGET LEVELS WOULD BE APPROPRIATE.

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Q. THE STANDARDS ARE LIKELY TO AFFECT SALES OF ELECTRICAL HVAC EQUIPMENT, CONTROLS AND LIGHTING FIXTURES. TO WHAT EXTENT WILL THE ELECTRICAL EQUIPMENT INDUSTRY BE DENIED ACCESS TO THE NEW RESIDENTIAL HEATING MARKET DUE TO WEIGHTING FACTORS?

A. ACEC CONSIDERS THIS QUESTION OF CRUCIAL IMPORTANCE TO THE ENTIRE CONSTRUCTION INDUSTRY. DOE SHOULD RESEARCH THE QUANTITIES OF ELECTRICAL EQUIPMENT UTILIZED IN NEW BUILDINGS AND TRACE THE ORIGIN OF SUCH EQUIPMENT. WE BELIEVE THAT WEIGHTING FACTORS SHOULD BE ELIMINATED TO AVOID HARDSHIPS WHICH WILL RESULT FROM MARKET SHIFTS OF THIS NATURE.

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Q. TO WHAT EXTENT WILL THE STANDARDS AFFECT THE USE OF THE ELECTRIC HEAT PUMP?

A. THE ELECTRIC HEAT PUMP HAS BEEN SHOWN TO BE A REMARKABLY EFFICIENT ENERGY CONSERVATION TOOL. ALTHOUGH HEAT PUMPS ARE NOT WIDELY USED IN THIS COUNTRY, THE GROWTH OF THE MARKET SHOULD BE ENCOURAGED. AS THE STANDARDS DISCOURAGE THE USE OF ELECTRICITY IN ALL NEW CONSTRUCTION, THE ELECTRIC HEAT PUMP WILL NOT BE WIDELY USED. DOE SHOULD RE-EVALUATE ITS ASSUMPTIONS OF HEAT PUMPS AND THE WEIGHTING FACTOR REQUIREMENTS.

Q. HAS DOE SUFFICIENTLY ANALYZED THE ECONOMIC EFFECTS ON LABOR AND THE BUILDING AND CONSTRUCTION INDUSTRIES?

A. IN ACEC'S OPINION - NO.

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Q. IS A MORE COMPREHENSIVE ANALYSIS REQUIRED?

A. YES.

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Q. SHOULD DOE SPECIFICALLY STUDY PARTICULAR INDUSTRIES, SOCIETAL GROUPINGS AND DIFFERENT TYPES OF OWNERS AND OCCUPANTS?

A. YES.

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IN OUR REVIEW OF THE LIFE CYCLE COST ANALYSIS IT IS NOT CLEAR WHAT EQUIPMENT EFFICIENCIES WERE USED. DOE SHOULD PROVIDE SUCH INFORMATION AS THIS IS VITAL TO OUR UNDERSTANDING OF THE LCC TECHNIQUES. IN ANY CASE, DOE SHOULD PROVIDE RECOMMENDATIONS ON MINIMUM APPLIANCE AND EQUIPMENT EFFICIENCIES AS THIS WILL HAVE A SIGNIFICANT IMPACT ON THE DESIGN ENERGY PERFORMANCE CALCULATIONS. IN THE ECONOMIC ANALYSIS NO CONSIDERATION IS GIVEN TO REPLACEMENTS OR RETROFITS OF NEWER APPLIANCES AND EQUIPMENT. SUCH RETROFITS ARE VERY LIKELY BASED UPON A 30 YEAR

ASSUMED BUILDING LIFE. DOE SHOULD PROJECT THE COST OF SUCH REPLACEMENTS AND MODIFICATIONS AS THIS IS A SIGNIFICANT COST FACTOR IN LCC ANALYSIS.

ACEC IS AWARE THAT THE ORIGINAL RESEARCH SAMPLE WAS NOT INTENDED TO BE USED TO ESTABLISH ENERGY BUDGET LEVELS. THE ORIGINAL INTENT OF DATA COLLECTED BY THE AMERICAN INSTITUTE OF ARCHITECTS/ RESEARCH CORPORATION WAS TO OFFER A "SNAPSHOT" OF DESIGN AND CONSTRUCTION PRACTICE IN 1975-76. THIS PRESENTS A SERIOUS STATISTICAL PROBLEM BECAUSE THE ORIGINAL SAMPLE WAS NOT SELECTED TO REFLECT REGIONAL VARIATIONS IN DESIGN PRACTICE, CLIMATE CONDITIONS, AVAILABLE MATERIALS, AVAILABLE SERVICES, ETC. NEVERTHELESS, THE DOE BUDGET LEVELS WERE BASED ON THE AIA/RC DATA. WE ARE CONCERNED THAT THE ASSIGNED ENERGY BUDGET LEVELS MAY NOT BE REPRESENTATIVE OF THE BUILDING TYPES AND CLIMATES STUDIED. FURTHER RESEARCH, BASED UPON METERED DATA OF EXISTING BUILDINGS, IS IN ORDER TO VERIFY THE ESTABLISHED FIGURES.

ACEC IS AWARE OF THE LACK OF DATA ON GROUND TEMPERATURES AND UNDERGROUND HOUSING (INCLUDING BASEMENTS). CALCULATIONS FOR RESIDENTIAL DESIGNS, INCORPORATING BASEMENTS AND CRAWL SPACES, SHOULD BE DEVELOPED. SUCH DATA SHOULD REFLECT THE STABILIZING CHARACTERISTICS OF SUB-TERRANEAN SPACES AND THE VARIATIONS IN MATERIAL CHARACTERISTICS REQUIRED FOR STRUCTURAL PURPOSES.

ACEC HAS PARTICIPATED IN DISCUSSIONS OF BUSINESS TAX CREDITS FOR BUILDING OWNERS AND DESIGNERS WHO ATTEMPT TO COMPLY WITH BEPS. WE BELIEVE THAT THE STANDARDS SHOULD BE IMPLEMENTED ON A VOLUNTARY BASIS AND, THEREFORE, FURTHER INVESTIGATION OF USING TAX INCENTIVES IS IN ORDER.

SUMMARY STATEMENT

THE AMERICAN CONSULTING ENGINEERS COUNCIL HAS SUPPORTED THE WORK OF THE DEPARTMENT OF ENERGY FOR THE LAST THREE YEARS. MANY OF OUR MEMBERS WITH SPECIFIC EXPERTISE HAVE PARTICIPATED IN VARIOUS ASPECTS OF THE BEPS RESEARCH AND DEVELOPMENT PROCESS. WE RECOGNIZE THAT THE TASK OF WRITING A NATIONAL ENERGY PERFORMANCE STANDARD FOR NEW BUILDINGS, ORIGINALLY ASSIGNED BY THE CONGRESS TO HUD, WAS AN OVERWHELMINGLY COMPLEX TASK. NEVERTHELESS, DOE PUT ITS BEST FOOT FORWARD ATTEMPTING TO INTERPRET THE ORIGINAL LAW AND MAKE SENSE OUT OF VAGUE AND AMBITIOUS CONGRESSIONAL MANDATES. ACEC UNDERSTANDS THE FRUSTRATION THIS PROCESS HAS CAUSED. IN OUR OPINION, PUBLIC LAW 94-385 IS LARGELY TO BLAME FOR THE MANY FAILURES TO ACT AND TO PRODUCE ADEQUATE RESEARCH RESULTS. THE UNACCEPTABLY SMALL RESEARCH SAMPLE (168 BUILDINGS), THE UNNECESSARILY COMPLEX STANDARD EVALUATION TECHNIQUE, AND THE RIDICULOUSLY DISRUPTIVE CONCEPT OF WEIGHTING FACTORS WERE, PERHAPS, UNAVOIDABLE STEPS IN THIS ATTEMPT TO MEET THE CONGRESSIONAL REQUIREMENTS.

ACEC CONTINUES TO SUPPORT THE BEPS PROCESS FOR ONE VERY GOOD REASON. THROUGH THE USE OF AN ENERGY PERFORMANCE STANDARD, ARCHITECTS AND ENGINEERS WILL BEGIN TO APPROACH DESIGN DECISIONS JOINTLY. BEPS WILL ENCOURAGE EARLY COLLABORATION BETWEEN ARCHITECTS AND ENGINEERS FOR THE SOLE PURPOSE OF AVOIDING UNNECESSARILY ENERGY CONSUMING SYSTEMS. THIS UNDERLYING THEME HAS BEEN ABUNDANTLY CLEAR THROUGHOUT THE RULEMAKING PROCESS. WE RECOGNIZE AND SUPPORT

THIS LONG OVERDUE NOTION OF A "TEAM APPROACH" TO ENERGY CONSERVING DESIGNS.

IN AS MUCH AS WE TAKE HEART WITH THE GOOD INTENTIONS ON WHICH THE PROPOSED STANDARDS ARE BASED, WE MUST EXPRESS OUR DISAPPROVAL OF CERTAIN ASPECTS OF THE RULEMAKING.

FIRST, WE DO NOT BELIEVE THAT ADEQUATE RESEARCH HAS BEEN UNDERTAKEN TO JUSTIFY THE CONCLUSIONS REACHED IN THE PROPOSED RULE. THE RESEARCH SAMPLE MUST BE EXPANDED.

SECOND, WE MUST INSIST THAT THE RESEARCH WHICH IS NOW ONGOING BUT INCOMPLETE, BE EXPEDITED TOWARD COMPLETION AND THE RESULTS MADE PUBLIC PRIOR TO THE PUBLICATION OF A FINAL RULE.

THIRD, WE STRONGLY OPPOSE THE USE OF WEIGHTING FACTORS TO INFLUENCE FUEL USE IN BUILDINGS. WE RECOMMEND ELIMINATION OF WEIGHTING FACTORS FOR THE VARIOUS FUEL TYPES ALTOGETHER.

FOURTH, THE MAGNITUDE OF THE POTENTIAL IMPACTS ON THE BUILDING INDUSTRY, AS DISCUSSED IN THE ECONOMIC AND ENVIRONMENTAL IMPACT STATEMENTS, ARE ENORMOUS. ACEC URGES VOLUNTARY APPLICATION OF THE BEPS, OVER AN EXTENDED TIME FRAME, TO CAUTIOUSLY AVOID HARDSHIP ON ANY ONE SEGMENT OF THE INDUSTRY.

FIFTH, ACEC MUST INSIST THAT DOE UNDERTAKE A DETAILED ASSESSMENT OF POTENTIAL INCREASES IN DESIGN TIME, COMPUTER TIME, AND ASSOCIATED COST INCREASES FOR DESIGN FIRMS. A REPRESENTATIVE NUMBER OF DESIGN

FIRMS SHOULD BE CONTACTED AND ASKED TO ESTIMATE COST INCREASES IMPOSED BY THE STANDARDS.

SIXTH, RESOLUTION OF THE DESIGN LIABILITY PROBLEM ASSOCIATED WITH THE ALTERNATE APPROVAL PROCESS IS ESSENTIAL. WE TRUST THAT THE WORK WE HAVE DONE IN CONJUNCTION WITH THE DESIGN PROFESSIONALS INSURANCE CORPORATION (DPIC) AND THE VICTOR O. SCHINNERER CORPORATION WILL RECEIVE DUE CONSIDERATION BY DOE. IT IS OUR HOPE THAT THE FINAL REGULATIONS WILL INCLUDE AN AFFIDAVIT ACCEPTABLE TO DOE AND ENDORSED BY THE INSURANCE UNDERWRITERS AND THE PROFESSIONAL DESIGN SOCIETIES.

SEVENTH, WE ARE DISTURBED BY THE SUGGESTION THAT COMPUTER SIMULATIONS WILL BE REQUIRED TO INDICATE COMPLIANCE WITH THE STANDARDS. WE SUPPORT SIMPLIFIED DESIGN TOOLS, INCLUDING MANUAL CALCULATIONS AND THE DEVELOPMENT OF A MANUAL OF ACCEPTED PRACTICES AS ALTERNATIVES TO THE USE OF EXPENSIVE AND TIME CONSUMING COMPUTERS.

EIGHTH, DOE HAS AN OBLIGATION TO BRING TO THE ATTENTION OF THE CONGRESS THE PROBLEMS ASSOCIATED WITH THE STATUTORY IMPLEMENTATION SCHEDULE. DOE SHOULD ASSERT ITSELF AND RECOMMEND TO THE CONGRESS A REASONABLE EXTENSION OF TIME TO IMPLEMENT BEPS.

NINTH, EFFORTS TO DEVELOP AND IMPLEMENT AN EDUCATIONAL PROGRAM FOR DESIGN PROFESSIONALS, CODE OFFICIALS, LEGISLATORS, AND COMPLIANCE PERSONNEL SHOULD HAVE BEGUN BEFORE THIS TIME. DOE SHOULD TAKE IMMEDIATE STEPS TO GET A COMPREHENSIVE EDUCATIONAL PROGRAM UNDERWAY.

TENTH, WE EXPECT TO SEE DOE ADDRESS EXISTING FEDERAL LAWS WHICH GOVERN SERVICES AND PROCUREMENT. REGARDLESS OF THE ULTIMATE IMPLEMENTATION APPROACH, DOE MUST TAKE STEPS TO REVISE OR REPEAL THE STATUTORY 6% DESIGN FEE LIMITATION FOR FEDERAL DESIGN WORK.

ALTHOUGH WE SUPPORT THE CONCEPT OF ENERGY PERFORMANCE STANDARDS AND THE ATTEMPT TO CONSERVE GREAT QUANTITIES OF ENERGY THROUGH DESIGN, WE SEE ENOUGH OF A JUSTIFICATION IN THE MATERIAL WE HAVE REVIEWED TO SUGGEST THAT DOE ISSUE A "REVISED NOTICE OF PROPOSED RULEMAKING" PRIOR TO FINALIZING THE STANDARDS. SO MUCH OF THE MATERIAL IS INCOMPLETE THAT WE MUST REQUEST ANOTHER OPPORTUNITY TO REVIEW AND COMMENT ON THESE PROPOSED REGULATIONS.

INASMUCH AS DOE FAILED TO EVALUATE THE ADDITIONAL COSTS TO DESIGN FIRMS FOR COMPLYING WITH BEPS, NO ANALYSIS WAS CONDUCTED OF THE NEED AND/OR THE AVAILABILITY OF ADDITIONAL A/E STAFF. THE CONSULTING ENGINEERING PROFESSIONAL IS ALREADY EXPERIENCING A SHORTAGE OF ENGINEERING TALENT. WE WOULD LIKE TO OFFER A BRIEF SCENARIO TO ILLUSTRATE A VERY RELEVANT POINT.

> IF A DESIGN FIRM EMPLOYS 10 PEOPLE AND THIS SAME FIRM HAS A HISTORY OF COMPLETING 10 NEW BUILDING DESIGNS EACH YEAR, WHAT WILL THE IMPACT OF BEPS BE ON THE PRODUCTIVITY OF THIS FIRM? LET US ASSUME THAT THE BEPS WILL INCREASE DESIGN TIME REQUIREMENTS BY 20% ON EACH OF THE 10 YEARLY PROJECTS. WITH NO ADDITIONAL STAFF ADDED TO RETAIN THE

NORMAL LEVEL OF PRODUCTIVITY THE NUMBER OF BUILDINGS DESIGNED IN A GIVEN YEAR WILL FALL FROM 10 TO 8. AT THIS POINT WE MUST TAKE A CAREFUL LOOK AT WHAT BEPS HAS DONE. INSTEAD OF PRODUCING 10 NEW BUILDINGS WHICH HAVE SLIGHTLY HIGHER LEVELS OF ENERGY CONSUMPTION, THE FIRM HAS PRODUCED 8 VERY EFFICIENT BUILDINGS. IN THE LONG TERM, THIS MAY HAVE A VERY POSITIVE IMPACT ON OUR ENERGY PROBLEM. HOWEVER, FOR THE SHORT TERM THERE IS 20% LESS CONSTRUCTION ACTIVITY AND 20% FEWER NEW BUILDING STARTS. DEPENDING UPON THE AMOUNTS OF ENERGY WE ARE TALKING ABOUT, THE IMPOSITION OF BEPS MAY HAVE A CUMULATIVE NEGATIVE IMPACT. IF A "PRUDENT ASHRAE" STANDARD CAN PRODUCE BUILDINGS WITH CONSUMPTION FIGURES WITHIN 2% OF THE PROPOSED BEPS, IS IT NOT OF GREATER "VALUE TO THE NATION" FOR THIS DESIGN FIRM TO PRODUCE 10 BUILDINGS PER YEAR INSTEAD OF ONLY 8? THE ASHRAE APPROACH IS FAMILIAR TO NEARLY ALL DESIGNERS AND WILL NOT BE AN IMPOSITION ON DESIGN FIRMS. ISN'T IT BETTER, FOR ALL CONCERNED, TO PRODUCE A SIGNIFICANTLY GREATER NUMBER OF BUILDINGS WHICH ARE SLIGHTLY LESS ENERGY EFFICIENT THAN THE BEPS BUDGETS, THAN IT IS TO SACRIFICE PRODUCTIVITY BY 20% FOR A 2% ENERGY SAVINGS?

ON BEHALF OF THE AMERICAN CONSULTING ENGINEERS COUNCIL, I APPRECIATE THIS OPPORTUNITY TO RESPOND TO THE PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS.

APPENDIX IX

Previous Testimony of the American Society of Heating, Refrigerating and Air-Conditioning Engineers Before the Committee on Governmental Affairs, U.S. Senate, Nov. 20, 1979; and the Department of Energy, Mar. 24, 1980; and ASHRAE Responses to November 1979 Department of Energy Notice of Proposed Rulemaking Energy Performance Standards for New Buildings

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Statement of Clinton W. Phillips

Vice President

American Society of Heating, Refrigerating and

Air-Conditioning Engineers

Before the

Committee on Governmental Affairs

United States Senate

November 20, 1979

Mr. Chairman and Members of the Committee:

Thank you for the opportunity to make the following brief statement on S. 1604 on behalf of ASHRAE, the American Society of Heating, Refrigerating and Air-Conditioning Engineers. My name is Clinton Phillips. I am currently a Vice President of ASHRAE and am a fellow in the Society. I am a registered professional engineer and currently serve as Manager of Integrated Energy Systems at the National Bureau of Standards.

ASHRAE is a research oriented, voluntary association of more than 39,000 members who have a professional concern with heating, cooling, ventilation and refrigeration in buildings. ASHRAE was founded in 1894 and is recognized throughout the world as the leading organization in its field. We are a technical society composed of consulting engineers, contractors, manufacturers, government officials and educators who are involved with commercial and residential building design and construction.

ASHRAE has a deep and direct interest in the development and implementation of Building Energy Performance Standards. Our involvement with energy standards for buildings goes back many years to the first efforts made in 1973 to develop such standards. These efforts resulted in ASHRAE Standard 90-75, which is the only recognized and widely adopted standard in existence today that deals with energy conservation in new buildings. ASHRAE is also about to issue a new series of standards to be known as ASHRAE Standard 100 which will deal with energy conservation for existing buildings, including low and high rise residential, commercial, industrial, institutional and public assembly buildings.

Let me briefly review for you the involvement that our society had in the development of ASHRAE 90-75. In July of 1973, the National Conference of States on Building Codes and Standards (NCSBCS) asked the National Bureau of Standards to develop an energy standard for new buildings, which resulted in a draft standard (Design and Evaluation Criteria for Energy Conservation in New Buildings) that was published in February of 1974. At that time, ASHRAE agreed to take the draft NCSBCS standard and develop it into a nationally recognized consensus standard. With a massive amount of time and effort over the next 1½ years, ASHRAE 90-75 (Energy Conservation in New Building Design) was finally published in August of 1975. This standard was then adapted into a model building code by NCSBCS under contract to DOE. The code version of ASHRAE 90-75 was issued in December of 1977 (Code for Energy Conservation in New Building Design). This model energy code, or similar adaptations of ASHRAE 90-75, has since been adopted by 3 major building code organizations (Building Officials and Code Administrators, Southern Building Code Congress International, and the International Conference of Building Officials) which has in turn led to implementation of an energy building code by most states.

In addition, the Energy Policy and Conservation Act of 1975 provided a strong push from the federal government for adoption of energy codes and standards for new building construction. ASHRAE 90-75 was established as the reference for the mandatory lighting and thermal efficiency standards to be adopted by the states under the State Energy Conservation Plan program of EPCA. To our knowledge, 45 states have since adopted or plan to adopt some form of ASHRAE 90-75 as part of their state building codes.

ASHRAE has had a long involvement with both HUD and DOE in a number of technical areas. It is not our purpose today to judge the merits of either agency as it relates to implementation of BEPS. Rather, we would like to offer our suggestion as to where the overall authority for BEPS is most appropriately placed. Both HUD and DOE have expertise in a number of areas that relate to BEPS and this expertise should continue to be used, regardless of which agency has the ultimate responsibility for the program. We do believe, however, that one and only one agency should be given total authority and responsibility for the entire BEPS program. One of the major reasons for having one agency responsible for BEPS is that the program involves many complex, highly technical issues that cut across both the development and implementation of the standards. There seems to be no logical reason for dividing responsibility for developing and implementing BEPS between two separate agencies. Because BEPS is an energy conservation program for all new buildings, it seems reasonable to us that DOE is the most appropriate agency to handle the BEPS program. However, HUD should continue to play an active role, particularly in the areas dealing with residential buildings where HUD has unquestioned expertise.

We would also like to offer a few comments on implementation of BEPS as it relates to existing energy standards, primarily ASHRAE 90-75. The energy standard embodied in ASHRAE 90-75 is a dynamic standard that is continuously revised, updated and improved as we learn more about saving energy in buildings. For instance, the standard is currently undergoing a major revision that will set more stringent requirements in 1984. This revision will be issued in the very near future.

We consider ASHRAE 90-75 to be a performance oriented standard that should be used as the foundation on which to develop and implement BEPS. Chapters 4-9 of ASHRAE 90-75 contain component performance requirements, which some have called "prescriptive" design criteria. However, since the earliest stages of development of the standard, Chapter 10 has allowed and encouraged alternate performance designs without regard to specified criteria _if_ the design meets or exceeds the energy efficiency obtained by following the minimum component requirements contained in Chapters 4-9. It appears that any type of BEPS approach will need to be measured against some established point of reference; and the only such available reference is the current ASHRAE standard. Our conclusion is that ASHRAE 90-75 should be the base on which BEPS is built and later implemented. We continue to urge DOE to use this approach. ASHRAE has been working closely with DOE to consider ways to incorporate BEPS into the framework of ASHRAE 90-75. One possiblity is to add BEPS as the substance of Chapter 10 in a future revision to our standard. We would urge this committee to provide DOE with direction on using the existing codes and standards based on ASHRAE 90-75 as the basis for implementing BEPS.

Energy use in buildings is an extremely complex and highly technical subject. Both DOE and HUD have done an admirable job in developing a theoretical data base on energy use in new buildings as part of the BEPS program. However, there are still a large number of issues to be resolved. The building industry is a large and diverse group of individuals ranging from building designers, to contractors, to hardware manufacturers and code officials. Simply mandating that a new type of energy standard be followed will not acheive the desired results until the technical issues are resolved, and unless all of the parties affected by the standard are adequately familiar with and support its use.

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Historically, energy use has not been a major factor in the design and construction of buildings because of the low cost of energy. Rather, more attention was paid to acheiving maximum comfort, often at the expense of energy efficiency. That situation has dramatically changed since 1974. We are now in a world of scarce and expensive energy. That fact by itself is rapidly driving the construction industry towards more efficient buildings because it makes economic sense. Any program such as BEPS that is designed to encourage further energy savings in buildings, but which does not build on the existing construction industry methods, particularly its established codes and standards, is likely to cause chaos, delay further progress towards the goals we are trying to acheive, and may, in the long run, be doomed to fail. There is a great deal of training and education to be done at all levels to properly apply and implement even the existing energy standards such as ASHRAE 90-75, to say nothing of what is required for a new approach like BEPS. We should not waste the substantial amount of knowledge already developed in implementing ASHRAE 90-75 by switching to a totally new, and technically more complicated approach. We sincerely hope DOE will see the wisdom of using what is already in place and building upon it rather than trying to replace it.

One final comment we would like to make concerns our desire to see the BEPS program adequately staffed and funded. Too often, new and extremely complex programs are not given adequate support and time for proper implementation. We believe that a properly designed energy standard using a BEPS approach could be significant in conserving more energy in buildings, but it must be given high priority in budget and manpower by both the administration and congress.

A closely related issue is the statutory time period required for implementation of BEPS. ASHRAE believes that the current 1 year period for implementing BEPS is not realistic and feels congress should consider a revised time schedule that allows the standards to be phased in. DOE should be given an adequate amount of time to further resolve complex technical issues before a final rule is published, and they should be given the authority to implement the standard over more than a year, perhaps three years or more. In developing ASHRAE 90-75, it took more than two years to develop the standard, more than two years to write a code version of the standard, and after nearly two more years, the code version is still not adopted by all states. Since more than 6 years has gone by since the concept of ASHRAE 90-75 was first initiated, it seems reasonable to expect that BEPS, which is more complicated and technically more difficult, will take a similar period of time. The adoption of building codes is, by itself, a very long administrative process.

Finally, I would like to assure you that ASHRAE plans to work with DOE on a continuing basis to develop ways to establish and implement a proper BEPS approach to building energy standards.

Thank you for the opportunity to present our comments. I would be happy to answer any questions.

REMARKS OF HUGH D. McMILLAN, JR.

HEARING ON THE PROPOSED ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS

Department of Energy
Washington, D.C.
March 24, 1980
11:30 a.m.

I am Hugh D. McMillan, Jr., of Houston. I appear here as president of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, a voluntary organization of 40,000 specialists in heating, cooling, ventilating, and refrigeration. Our members come from manufacturing companies, design firms, utilities, distributors, engineering schools, and government at all levels. Many of them are experts in energy conservation in buildings.

Congress has given you the assignment of drafting Building Energy Performance Standards, or BEPS. You have tried conscientiously to carry out the task given to you by Congress. However, I fear that an idea which is sound in principle will fail because there is insufficient time to develop it completely. That would harm the national effort to conserve energy and, incidentally, it would add to the inflationary pressures.

Here are some of our major concerns with the BEPS as they now stand:

1. We recognize the long-term savings resulting from energy conservation. However, we believe that significant increases in design costs and enforcement costs have not been given adequate consideration. BEPS will add a minimum of $2,000-3,000 to the design costs of commercial buildings (and perhaps as much as $10,000) and $200-300 to the design cost of a single-family home. They will add an additional but undetermined amount to the cost of enforcement. Further, additional time required may result in construction delays which again increase costs.

2. The BEPS require a computerized energy analysis. Most design firms are small (more than 60% have 12 or fewer employees) and four out of five presently have no experience with computerized analysis procedures. Accordingly, the BEPS plan effectively discriminates against these small businesses.

3. The research on which BEPS are based is impressive and valuable. Unfortunately, however, it is incomplete. We have found 13 places--and there may be more--in which the Notice of Proposed Rulemaking states that research is still in progress. We do not believe it is prudent to move ahead before the research is finished, verified and field tested.

4. Further, the documentation of the research which has been concluded is not complete. Many of the technical support documents are incomplete, vague, and in some cases, appear to have been written in great haste.

5. The proposed BEPS budgets were based in large part on a relatively small sample. We believe some of the present budgets are inconsistent and inequitable. Additional consideration should be given to:

- the building classifications
- the effects of building size
- climatic factors
- the effects of special operating requirements
- the impact of weighting factors.

Further, only buildings designed by architects and engineers were included in the sample. There are tens of thousands of buildings each year designed by their builders. Doesn't it skew the results to omit them from the sample?

6. The stated purpose of the BEPS is to encourage innovative design. Yet the standard evaluation technique (SET) procedures are so complex, and in many ways so rigid, that I fear they will have just the opposite effect.

7. The DOE has not yet presented an implementation plan. We believe it would be unwise to adopt a final rule covering BEPS without having an accepted plan for carrying out the provisions of the rule.

These and other concerns are detailed in a statement too long to read here, which I shall leave with you.

In summary, I would like to offer one additional observation and several recommendations. It is evident that additional time is required to complete the research, development and implementation of BEPS. In the interim, we recommend that the DOE insure energy conservation in new building design by continuation of the programs it initiated under PL 94-163.

It is not as though there is no mechanism to bring about energy conservation in buildings. There is: ASHRAE Standard 90, entitled, "Energy Conservation in New Building Design." Codes based in whole or in part upon it are now in effect in 44 states. They are saving energy right now--25% to 35% in comparison to 1975 design practices! It is ASHRAE's position that as Standard 90-based codes are in place and a proven means of assuring energy efficient building design:

- That there is a significant advantage for the nation in maintaining and strengthening these standards and codes rather than replacing them with the whole building performance approach as proposed,
- That it is in the interest of our nation to implement a BEPS program with equivalent subsystem performance standards in parallel with the whole building performance procedures presented in the November, 1979, Notice of Proposed Rulemaking,
- That a realistic time schedule spanning a three to five year period be provided for the completion of the development and implementation process.

Thank you for the opportunity to make this statement.

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ASHRAE RESPONSE TO THE NOVEMBER 1979
DEPARTMENT OF ENERGY
NOTICE OF PROPOSED RULEMAKING
ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS

Thank you for the opportunity to make the following statement on behalf of ASHRAE, American Society of Heating, Refrigerating and Air-Conditioning Engineers. My name is Hugh D. McMillan, Jr. ,President of ASHRAE.

ASHRAE, founded in 1894, is a non-profit research and technically oriented society of more than 40,000 members representative of consulting engineers, contractors, manufacturers, government, educators, users and research institutions dedicated to the advancement of the arts & sciences and allied arts & sciences in the fields of heating, refrigeration, air-conditioning and ventilation for the good of the general public.

Building Energy Performance Standards (BEPS) have been of concern to ASHRAE since January 1974 when we made a commitment to develop Standard 90, which is a combination of building subsystem and component standards (BEPS, SEPS and CEPS respectively). We, at that point, initiated a commitment to the improvement of the energy efficiency of the nation's buildings and continue to support strongly any activity which will provide a practical means of achieving that end. These efforts produced ASHRAE Standard 90-75, "Energy Conservation in New Building Design," the nation's first systematic plan to cut energy consumption in new construction. The hundreds of thousands of hours of volunteer effort provided by ASHRAE members to develop building energy standards, the expenditure of hundreds of thousands of ASHRAE dollars in support of this activity, and the more than 100 seminars conducted by ASHRAE to acquaint engineers, architects, and code officials with Standard 90 amply demonstrate the extent of this extraordinary commitment.

We also advise that a performance option has been part of our building energy standards effort since its inception in 1974. Engineers are performance-oriented people. Sections 10 and 11 of Standard 90 were developed and included to provide flexibility, to accomodate innovative design solutions, and to provide a means of considering the use of renewable resources.

Further, the ASHRAE Board of Directors reenforced this position and passed a resolution endorsing the concept of energy performance standards in January, 1979. However, it has been our experience in the development of the basic algorhythms for energy calculation methodologies and in the development of Standard 90, that the subsystem performance approach (SEPS) works better under present conditions than the whole building performance approach (BEPS). Therefore, our primary focus has been with the subsystem-oriented performance procedures. Although Federally funded efforts to develop the whole building performance procedure has contributed significantly toward moving BEPS forward, it is our opinion that a significant number of technical and implementation problems remain unresolved. We, therefore, urge the Department of Energy to examine carefully all the alternatives available to them to provide the nation with a practical, enforceable, and efficient building energy standard.

The uncertainty as to whether the whole building performance standards approach will work efficiently, and a strong belief that viable alternatives are available, brings ASHRAE to this hearing today. We believe that a multiple path approach with subsystem performance standards in parallel with the whole building performance approach, coupled with a realistic plan for implementation, would provide a viable solution to our nation's energy conservation needs. We, therefore, present the following statement of position, express certain concerns and reservations with regard to the proposed rule, and to offer suggestions as to what we think can be done to move the cause of energy conservation forward.

It is ASHRAE's position that:

- THE PROMULGATION OF BUILDING ENERGY PERFORMANCE STANDARDS WHICH DO NOT MAKE SPECIFIC PROVISIONS FOR A SUBSYSTEM-ORIENTED PERFORMANCE COMPLIANCE PATH WILL NOT ACHIEVE THE GOVERNMENT'S ENERGY CONSERVATION OBJECTIVES.
- THE COMPLEX NATURE AND BROAD IMPACT OF BUILDING ENERGY PERFORMANCE STANDARDS IS SUCH THAT A PHASED IMPLEMENTATION PROGRAM, DEVELOPED IMMEDIATELY AND TO BE EFFECTED OVER A 3-5 YEAR PERIOD, IS ESSENTIAL.

In support of our position, we offer the following comments and expressions of concern. They are grouped in four categories: technical problems, implementation problems, economic problems and problems related to time. Some of our comments fall into more than one category. For example, if an implementation plan had been presented that clearly defined the equivalent paths, indicated sufficient time for completing the research necessary to resolve technical, economic, and training questions, many, if not most, of these concerns could have been set aside.

TECHNICAL QUESTIONS

1. An extensive research effort has been carried out in support of the BEPS program. It appears that a great deal has been accomplished in the time available, however:
    a) Many of the technical support documents are incomplete, vague and, in some cases, appear to have been written in great haste. As government rulemaking procedures require full disclosure of supporting information, we say that the technical basis for BEPS should be more clearly and fully presented for public review.

b) Research efforts are still in progress in at least 13 cases, according to the NOPR. When completed, significant change in the rule could result. These research results and the consequent changes should also be made available for review.

Our concern here is not only with what has been done but what is yet to be done.

2. The proposed BEPS budgets were derived in large part from specific analysis of a relatively small building sample. For example, in the commercial category there were 125 buildings from 37 Standard Metropolitan Statistical Areas and all were designed by architects and engineers. The need for the use of sampling techniques is understandable. However, a review of the budgets for the 16 building types in 78 Standard Metropolitan Statistical Areas indicates a number of inconsistencies and inequities. The budgets presented in the NOPR in Tables I-1 and I-3 need to be reviewed and reevaluated. Particular attention should be given to the adequacy of:

a) The building classification scheme (due to the wide range of function within specified building types).

b) The effects of building size and shape.

c) The limited number of locations for which climatic data is specified and the selection of alternatives based purely on degree days (for example, there appear to be discrepancies in the levels of stringency in different climatic zones).

d) The effects of special operating conditions within a single classification.

e) The manner in which the weighting factors were developed and applied.

f) The exclusion from the sample of buildings not designed by architects and engineers.

A mechanism is needed for field testing and verifying the reasonableness of the design energy budgets proposed in Tables I-1 and I-3 of the NOPR for each Standard Metropolitan Statistical Area. We believe this can and should be accomplished through phased implementation processes.

3. The NOPR raises questions relative to possible conflicts between building energy conservation efforts and health and safety standards. Specifically, current research on indoor air quality raises serious questions as to the advisability of reducing outdoor air for ventilation. The NOPR states that the standard building operating conditions provide adequate ventilation. However, it is not clear that these criteria were adhered to in all the "redesign" buildings which were used to justify the budget levels selected. As ventilation loads are significant, we believe it is essential that DOE verify that the "redesign" building data are based on adequate ventilation rates.

4. The standard evaluation techniques as proposed in the NOPR and in TSD-1 present some particularly difficult technical problems. The complexity of the analysis and computational procedures is overwhelming. When only one in five existing design firms has any computer capability, it concerns us greatly that a computerized analysis is required by the present standard evaluation technique.

We agree with the statement in Section 4.3.1 of the NOPR that "The current state of the art in building energy calculation is not sufficiently developed to support a single computer program for the energy analysis of all building classifications; heating, ventilation and air-conditioning systems; lighting; domestic hot water heating systems; and nonrenewable energy sources."

We, however, do not agree that the combination of programs chosen eliminates the problem. The justifications for the proposed S.E.T. presented in the NOPR and TSD-1 are not convincing for the following reasons:

a) Some systems currently in use cannot be adequately simulated by the S.E.T. nor can innovative approaches which are supposed to be encouraged by the performance approach be analyzed.

b) The complexity of the computation procedures is so great that it is not possible for practicing professional architects and engineers to adapt them to analyze new systems concepts.

c) In the programs listed, the analysis capability in the equipment and control area is severely limited.

d) There are control strategies with significant potential for energy conservation which appear to be excluded from consideration by the input requirements of the S.E.T. Some are of the opinion that even an established technique such as dead band control is eliminated from consideration. Such limitations on compliance strategies are unreasonable.

e) In view of the five or more years required to bring the analysis programs to their present state, we have no assurance that promised procedures for the analysis of daylighting and renewable resource alternatives will be available, and verified, prior to promulgation of the rule.

f) Even with the limitations imposed by the S.E.T., there are a sufficiently large number of decision points in the analysis procedure that two competent and conscientious professionals attempting to model a system which does not precisely fit the standard systems covered by DOE-2 could arrive at significantly different answers. Knowledgeable, but unscrupulous individuals could manipulate this complex procedure to arrive at almost any desired answer.

We have one further concern. Limitations in the capability of the S.E.T. analysis tools, limitations on control and operating strategies, and the unreasonable difficulty of analyzing anything other than the limited number of standard systems presently included in the DOE-2 program combine to produce a procedure much more restrictive to innovative and efficient design solutions than compliance with subsystem-oriented performance standards.

It, therefore, appears that DOE is in a dilemma. If it limits flexibility for the sake of precision, it defeats the intent of the performance approach. If it is sufficiently flexible to allow for innovative design solutions, it may compromise precision. We strongly urge DOE to reevaluate the options outlined in Section 4.1 of TSD-1. Considering the current state of the art, we cannot agree that there is an advantage in the proposed procedure.

IMPLEMENTATION PROBLEMS

Our primary concern and comment in this area is that the implementation plan has not yet been made available for public review and comment. It is unwise to implement a final rule covering the BEPS procedure without a specific method of carrying out the provisions of the rule. However, since Section 5 of the NOPR does open the implementation problem for comment at this time, we would like to do so to the extent possible.

1. The NOPR indicates DOE's intention of prequalifying "equivalent" subsystem based performance standards. We believe such action is essential. Neither the existing system for the regulation of building construction nor practicing design professionals can shift from established energy standards to the whole building approach within the presently specified time period. The design and construction industry is diverse, and the time required to introduce change without chaos is substantial. Most design firms and code enforcement agencies have small staffs. This complicates and extends the training process and may impose a significant burden on these firms and agencies.
2. As BEPS is presently written, the budgets are referenced to design energy performance. We recognize the necessity of this approach. However, building owners will expect building operating energy performance to coincide, within

reasonable limits, with the BEPS budget. As many building operating schedules differ from those proposed by standard building operating conditions, such expectations may place designers in jeopardy by exposing them to lawsuits. A clear indication of the differences, and the causes for such differences, between design energy performance and actual operating performance, must be provided to avoid unnecessary conflict and litigation.

3. The present structure of the weighting factors creates serious inequities. National level weighting factors are not acceptable. ASHRAE's experience with RUFs and RIFs has demonstrated the complexity of the issues involved and the difficulty of resolving them. Simply combining them and calling the product a "weighting factor" does not lessen the magnitude of the problems. The NOPR approach may lead to counterproductive results. For example, the national level weighting factors may encourage heating with oil instead of coal or hydro generated electricity in some areas. The issues involved and the ultimate impact of decisions go far beyond the building community.

ECONOMIC PROBLEMS

ASHRAE recognizes the life-cycle cost benefits which arise from energy efficient design. However, we do not believe that potentially significant increases in first cost, design cost, and enforcement cost can be overlooked. The NOPR and TSD-8 conclude that the first cost of commercial buildings designed under BEPS will increase only 3 to 5%. We consider these estimates to be low. They do not account for realistic increases in design cost and enforcement costs. The costs of educating and equipping code officials and design professionals to deal with the complex whole building performance procedures, additional design costs, and enforcement costs (including the necessity of enlarging staff and upgrading the technical capabilities in the thousands of code enforcement agencies throughout the country) have not been given adequate consideration.

These estimates also do not reflect current design experience. Although hvac system design capacities are decreasing, hvac system costs are remaining relatively constant. Cost reductions resulting from the lower capacities are being offset by the cost of increasing equipment efficiency and by providing more sophisticated system control. We offer the following points in support of this general statement:

1. In developing its 1979-80 directory, American Consulting Engineers Council determined that 63% of the 3,433 firms listed employed 12 or fewer employees. We think these figures are representative of firms in the design area. With training requirements expected to run from 40 to 80 hours and initial building analyses to run upwards from 80 hours each, it is evident that a requirement to use the performance approach would impose a substantial initial burden on small businesses. In estimating these costs, one must include the cost of lost time during the training period. Even though personnel time required for an analysis can be expected to drop with experience, costs will continue to be significant when compared to total fees experienced in the recent past.
2. In estimating increases in design costs, attention seems to have been focused on direct charges for computer use. Although these costs may not be negligible, they are only a small fraction of the total cost of a whole building performance standard analysis. The time requirements for developing the input and checking the output are substantial. Experience with a number of computer programs,including DOE-2, indicates that data take-off and input preparation will require from 20 to 50 personnel hours for the first run on each building. Time required for subsequent runs on the same building will be less, but experience also indicates that on the average, two or more runs are required for each analysis.

Additionally, it must be recognized that more than one analysis run will be required in virtually every case. The run for demonstrating compliance with the design energy budget will serve only that purpose.

With the restrictions built into the S.E.T. the probability that the BEPS run will be representative of the actual design and operation for a building is extremely small. The prudent design professional will insist on at least one additional run which will match, if possible, the actual control and operation schedules which will be used in the building in the hope of demonstrating the difference between the design budgets and what might reasonably be expected.

When considering the overall impact of these costs, it should be noted that of the 71,733 nonresidential buildings in the 1975 F.W. Dodge Report, 71,284 were four stories or less and the average size was under 10,000 ft^2. Analysis costs do not decrease proportionally with building size.

Estimates of the cost for the architect or engineer to determine compliance with subsystem-oriented performance standards for buildings of this size are on the order of $300 to $500 while for the whole building performance standards utilizing computerized analysis, they are $2,000 to $3,000. A complete energy analysis involving early estimates in the design phase, the analysis of systems options, and finally, determination of BEPS compliance is expected to cost on the order of $10,000.

3. The additional costs which will be incurred by code enforcement agencies have not yet been determined. Field experience with SEPS-based codes indicates an increase of about 15% in the budgets of enforcement agencies has been required. The SEPS-based codes are procedurally much simpler than the proposed BEPS procedures.

Irrespective of the life-cycle cost justification, implementation of whole building energy standards would create serious dislocation in the costs of building design and code enforcement. These impacts must be addressed realistically and dealt with prior to the implementation of any whole building energy performance approach as a mandatory standard.

4. The NOPR places a great deal of stress on economic analysis in support of the budget values chosen. Economic and cost data for the buildings in the sample are extremely sketchy, and the adequacy of the data base in projecting future costs of operation is questionable. The only operating cost data available are general costs based on actual usage from highly aggregated samples. There is concern about their applicability to the design energy consumption (based on the standard building operating conditions) determined in the DOE studies.

   The use of national prices and escalation rates is also questionable as a basis for setting budgets that must be met under local conditions.

   Further, assuming fuel cost escalation beyond anticipated costs for nondepletable and renewable resources is unrealistic. The number and complexity of the assumptions in the economic analysis is excessive.

PROBLEMS RELATED TO TIME

Here our position can be stated succinctly. Although we support a whole building performance concept, we do not think that it can be reasonably implemented in the time-frame required by Public Law 94-385. The research and development essential to the success of the performance procedures have not been completed. The performance approach will require a significant retraining effort among practicing professionals and code officials. The political process and subsequent enforcement procedure in many states and localities are not now structured in such a way as to obtain a response in less than two to three years. It is essential that Congress recognize these needs and constraints in planning both the rule and implementation procedures. As an immediate step we would urge DOE to continue its support of the building energy standards effort initiated under PL 94-163.

At the present time ASHRAE Standard 90-based codes are in place in 44 states. These standards have been subjected to the kind of consensus review recommended by OMB Circular A119, dated January, 1980. The mechanism for updating and strengthening these standards is also in place. The review process of Standard 90.1-75R, is presently nearing completion. We envision further review and revision in the future. Standard 90 and its derivative codes do, in fact, effect a substantial energy saving as compared to 1975 design practice. The AIA/RC report, "Analysis of ASHRAE 90-75R" January 1980, developed as a part of the DOE sponsored BEPS program, demonstrates that the interpretations of 90-75R, as tested, indicates overall energy savings of from 25% to 35% compared with 1975 design practice. Similar results were indicated in the A.D. Little Co. report entitled "An Impact Assessment of ASHRAE Standard 90-75." Further refinement of Standard 90 (90.1) has produced more stringent criteria and will provide additional savings.

The combination of uncertainty as to the practicality of implementing the whole building performance standards and the assurance that existing standards are saving energy brings into question the advisability of shifting the emphasis of the building energy standards efforts to the whole building approach in the near future. We do, however, believe that ultimately a multiple path approach, with subsystem-oriented performance standards in parallel with the whole building performance approach, will provide a viable solution to our nation's needs.

SUMMARY

It is ASHRAE's position that because Standard 90-based codes are in place, and they are proven means of assuring energy efficient building design:

- That there is a significant advantage for the nation in maintaining and strengthening these standards and codes rather than replacing them with the whole building performance approach as proposed,
- That it is in the interest of our nation to implement a BEPS program with equivalent subsystem performance standards in parallel with the whole building performance procedures presented in the November, 1979, NOPR,
- That it is essential that subsystem-oriented performance standards or codes remain as one of the paths for compliance with BEPS and applicable for all buildings--all sizes, all types, and in all locations.

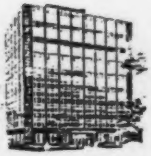
Further, we wish to recommend:

- That research, development, and education programs be continued in support of the energy standards effort,
- That economic issues be addressed and resolved,
- That a sound implementation plan be developed with consensus support from the building community and state and local officials,
- That DOE reconsider its options for establishing a standard evaluation technique, and
- That a realistic time schedule spanning a three to five year period be provided for the completion of the development and implementation process.

Our hope is that DOE will recognize the necessity of reevaluating the current plan and programs and will in the end present to Congress and the American people realistic and effective plans for assuring the design and construction of energy efficient buildings.

APPENDIX X

Comments of the National Coal Association, Docket No. CAS-RM-79-112



NATIONAL COAL ASSOCIATION

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CARL E. BAGGE
President

April 30, 1980

Ms. Joanne Bakos
Office of Conservation and
Solar Energy
Department of Energy
Room 6A-034
1000 Independence Ave. S.W.
Washington, D.C. 20585

Subject: Comments of National Coal Association,
Docket No. CAS-RM-79-112.

Dear Ms. Bakos:

I enclose for filing in the above-captioned docket the detailed comments of the National Coal Association upon the proposed rulemaking by the Department of Energy ("DOE") entitled "Energy Performance Standards for New Buildings." (44 Fed. Reg. 68120, November 28, 1979.)

For your convenience, I also enclose a copy of the testimony which I presented to your hearing on March 24, 1980, in Washington, D.C.

The National Coal Association represents firms producing most of the nation's coal, and other organizations concerned with coal production, transportation, and use.

GENERAL COMMENTS

Briefly, NCA's comments and my testimony make the following points:

. The "weighting factors" aspect of the proposed Building Energy Performance Standards ("BEPS") and the concept of "source energy" should be eliminated from any final rulemaking. This aspect of BEPS as now proposed would encourage continued reliance upon insecure

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foreign sources of energy by creating a strong bias against the use of electricity generated by domestic energy resources. This bias would favor oil and natural gas for use at the site in space heating and cooling. The use of such weighting factors would maximize the economic risk to energy consumers, as the costs of the favored fuels continues to increase disproportionately to the costs of the variety of fuels which may be used to generate electricity. The dimensions of this risk are perhaps most clearly demonstrated by the already major discrepancies between the projections of fuel prices upon which BEPS have been based and current world oil prices.

. Implementation of BEPS so as to favor oil and natural gas over electricity is contrary to current sound national policy to conserve nonrenewable domestic energy resources for their highest use. In the case of oil and natural gas, this policy argues for conservation of such fuels for industrial applications and as feedstocks.

. BEPS would tend to discourage the construction of more energy-efficient buildings, and create economic incentives to design choices which would not achieve maximum conservation of energy.

. BEPS would increase the cost of future construction by imposing excessive administrative and regulatory complexity upon the housing industry. It would be difficult if not impossible for the private sector to utilize the complicated computer models and programs that would be necessary to implement BEPS with the desired degree of specificity and validity.

. The states will be unable to implement BEPS as proposed. Massive federal, state, and local bureaucracies would have to be created. Major federal training and promotional programs would be required, to identify and induce changes in existing programs at the state and local level to conform to BEPS. Even if such major changes were possible within the relevant time frames, this result would clearly violate a major intent and purpose of the Congress to utilize state mechanisms for implementing energy conservation measures addressed to new building construction.

In addition to the above policy and implementation problems presented by the proposed rulemaking, we also note very significant technical anomalies that would result from the specific requirements of BEPS. These include engineering problems associated with the use of standard operating conditions, the components which are to be included in the budgets for building functions, the use of the Standard Metropolitan Statistical Areas as bases for climatic determinations, and the use of average national projected prices to establish key elements of the calculations needed.

We have reviewed many of the statements submitted at the Department's hearings, and are confident that these technical aspects will be addressed in greater detail by expert comment from the industrial sectors involved. At this time, we endorse the grave concerns so far expressed on these issues, and question the adequacy of the conclusions which DOE has drawn from the relatively limited and now outdated sampling which was undertaken to support BEPS.

POLICY CONSIDERATIONS

We believe that the goal of the Congress in the Energy Conservation and Production Act (ECPA) was to encourage more efficient energy conservation in new buildings. We believe that this expresses a sound and imperative national policy. We do not believe that BEPS as now proposed represents a sound implementation of that policy.

In BEPS, the DOE seeks to achieve effects not directly related to the goal of ECPA (e.g., disincentives to the use of electricity and the innovative conservation technologies made possible by it). In this effort, the Department has not merely failed to implement the policy expressed in ECPA in the most efficient manner; it has directly violated that intent. BEPS as proposed would run directly contrary to ECPA, and to national policies explicitly set forth in such other legislation as the Powerplant and Industrial Fuel Use Act of 1978 (PIFUA, P.L. 95-620).

IMPORTANCE OF IMPLEMENTATION POLICY

We note that the actual impacts of many of the problems, questions, and deficiencies addressed in our comments will vary depending upon how BEPS are actually proposed to be implemented by federal, state, and local authorities in the future. The critically important rulemaking on implementation has not yet been completed, or published in draft form for public comment.

The Supplement to the Draft Environmental Impact Statement on BEPS (DOE/EIS 0061/DS) addressed to the implementation of BEPS has only recently been published. Our preliminary review of this draft EIS supplement raises serious concern that the positive impacts of BEPS have been systematically overstated, and the negative impacts upon housing starts and the cost of new construction have been understated. The alternative programs of sanctions and incentives described therein raise extremely serious questions of the appropriate federal role in implementing ECPA as now drafted. These questions in turn would raise fundamental issues for the Congress when it is called upon to decide whether in what form sanctions should be imposed for failure or inability to implement the extremely complex substantive program described in BEPS.

RECOMMENDATIONS

The nation's future energy consumption and conservation patterns would be seriously affected by BEPS. The national security questions raised by any program which would tend to increase reliance upon fuels already being imported at unacceptably high levels must be addressed and adequately answered before responsible rulemaking may take place under today's energy and economic national priorities. As noted in the proposed rulemaking, many of the research projects and many of the serious questions already raised in the rulemaking to date have not yet been completed, or remain unanswered.

For all these reasons, the DOE at a minimum should defer further rulemaking at this time. The substantive questions raised with respect to the BEPS program and the procedural questions foreshadowed by the Draft Environmental Impact Statement upon the implementation program should be reviewed with the public and with the Congress in greater detail before final regulatory action is taken on either aspect.

In substantive final rulemaking, the concept of weighting factors should be abandoned. BEPS promulgated in compliance with ECPA should be directed toward energy consumption at the site (i.e., stated in terms of heat loss per square foot for a building thermal envelope, or in terms of component energy consumption). This would properly direct the thrust of BEPS to the amount of energy consumed at the building site, eliminate improper disincentives to the use of more abundant domestic energy resources, provide the maximum incentive for the construction of the most energy-efficient new buildings, and most closely approximate the regulatory mechanisms and methodologies now in use at the state and local level.

CONCLUSION

We concur with the policy expressed by the President in his National Energy Plan, that "[r]esources in plentiful supply should be used more widely as part of a process of moderating use of those in short supply." In this regard, the President further noted

> "To the extent that electricity is substituted for oil and gas, the total amounts of energy used in this country will be somewhat larger due to the inherent inefficiency of electricity generation and distribution. But conserving scarce oil and natural gas is far more important than saving coal." (National Energy Plan, April 1977, at xii-xiii.)

We endorse the President's conclusion. We understand it to be fully in accord with the policy and goals of the Congress, and we are confident that when the issues raised by NCA and others have been reviewed, the DOE will make material and substantial changes in the approach now taken.

Very truly yours,

Carl E. Bagge

Enclosure

UNITED STATES OF AMERICA
BEFORE THE DEPARTMENT OF ENERGY
OFFICE OF CONSERVATION AND SOLAR ENERGY

Proposed Rulemaking, "Energy)
Performance Standards for)
New Buildings" (44 Fed. Reg.) Dkt. No. CAS-RM-79-112
68120, November 28, 1979)

COMMENTS OF THE NATIONAL COAL ASSOCIATION

INTRODUCTION

The National Coal Association (NCA) represents firms producing most of the nation's coal, and other organizations concerned with coal production, transportation, and use.

By the above-captioned Notice of Proposed Rulemaking, the Department of Energy ("DOE") proposes to establish energy performance standards for new buildings pursuant to the provisions of the Energy Conservation and Production Act, P.L. 94-385, 42 USC 6801, et seq. (ECPA). The proposed rulemaking would create what has become commonly referred to as "building energy performance standards," or "BEPS". The Notice of Proposed Rulemaking ("NOPR") was preceded by an Advance Notice of Proposed Rulemaking. 43 Fed. Reg. 54522, (November 21, 1978). As now published for public comment, it is the first stage in the regulatory process set forth in the ECPA. Proposed regulations whereby the substantive performance standards created by BEPS would actually be implemented by the states have not yet been published.

NCA herewith submits its comments upon the proposed rulemaking.

Our comments will address first our substantive concerns with BEPS as now proposed, in the form of General Comments. We will then address specific elements of the proposed rulemaking, as published in the Federal Register. Our comments upon the various Technical Support Documents ("TSDs") published in support of the rulemaking will be included as appropriate, by reference to the documents themselves.

GENERAL COMMENTS

NCA strongly opposes promulgation of BEPS as now proposed. The use in BEPS of the concept of "source energy" and the employment of "weighting factors" would have major adverse consequences, which would contravene or undermine national energy and economic policies of overriding importance. Inclusion of these elements in BEPS would frustrate achieving the goals of energy conservation and administration by the states set by the Congress in ECPA, would run contrary to current national policies to reduce reliance upon insecure foreign sources of fossil fuels and encourage instead reliance upon domestic energy sources, and would introduce major delays, uncertainties and unnecessary (and thus inflationary) costs upon the already depressed building construction industry.

More specifically, BEPS would support already unacceptably high levels of imports of oil and natural gas. By encouraging use of such fuels for space heating in homes, they would run contrary to our national policy of conserving scarce, nonrenewable domestic energy resources for their highest uses (such as industrial processes or chemical feedstocks).

The strong economic incentive to the use of oil and gas will inevitably be reflected in the use of less costly and less efficient energy conservation technology in new buildings. The principal thrust of the weighting factors is therefore to encourage less efficient, not more efficient, buildings.

Finally, because of the major differences between the approach taken by BEPS and the building codes and other legal mechanisms already in force in the States, it is unlikely that states will be able to implement BEPS as intended by Congress. At a minimum, major federal assistance and bureaucracies would be required to implement BEPS as now drafted. This would run contrary to the strong policy of this Administration to avoid unnecessary, duplicative and wasteful federal expenditures of resource and personnel.

The analysis and documentation produced by DOE itself demonstrates that ECPA can be implemented more efficiently, more quietly and more fully in accord with Congressional intent, by deletion of the concepts of "weighting factors" and "source energy."

THE REGULATIONS

As discussed in more detail below, BEPS as now proposed would create a federal performance standard applicable to the granting of permits for new building construction. This would require the calculation for each new residential or commercial building of a "design energy budget." This "design energy budget" would express, in British thermal units per square foot per year, the total amount of energy which may permissibly be consumed by the new building.

The designer of any such new building, would be required to make a calculation of its actual estimated energy consumption. The actual estimated energy consumption would then be required to be adjusted based upon "weighting factors" derived from the specific choice of the "fuel" to be used with respect to the consumed energy. (For this purpose, electricity, oil, and gas are separately considered as "fuels," with separate weighting factors allocated to each.)

The resulting value, so adjusted, would be the "design energy consumption" of the proposed building. This would be required to be compared to the design energy budget. Through the operation of permit mechanisms for new buildings under building codes, etc., permission to construct the building would be contingent upon meeting or exceeding the design energy budget.

THE WEIGHTING FACTORS

The ECPA contemplates administration of the BEPS program by the States, through state and local laws. Extremely serious sanctions are provided for states unwilling or unable to accept the responsibility, including withdrawal of all federal funding or federally insured funding from private lenders within the state.

The weighting factors are expressed in the NOPR as:

	Natural Gas	Oil	Electricity
Single-Family residential . .	1	1.22	2.79
Commercial and multi-family residential	1	1.20	3.08

The effect of the weighting factors is, thus, to create a penalty of roughly three-to-one against the use of electricity in new buildings, a penalty of 1.2-to-1 for the use of oil, and no penalty for the use of natural gas. (NOPR, at 68138)

The use of weighting factors thus creates a strong economic bias against the use of electricity and in favor of the use of oil or gas. Stated differently, a designer would be able to "spend" roughly three times as many Btu's of energy if he were to use oil or gas as opposed to electricity. This would have the following adverse effects:

> To the degree that new construction would use oil or natural gas instead of electricity, it would support continued reliance upon insecure foreign sources of energy.

This is inconsistent with our national policy of reducing reliance upon such foreign energy sources. Data prepared for the President's Commission on Coal and set forth in the Staff Findings of the Commission published in March, 1980, disclose that in 1978 coal was used to generate 44 percent of the nation's electricity, oil and gas 30 percent, and nuclear, hydropower, and other sources a total of 20 percent. By 1985, coal is projected to account for 50 percent of generated electricity, with oil and gas reduced to 21 percent and nuclear and hydro increased to 29 percent. By 1990, coal is projected to be used to generate 54 percent of the nation's electricity, with oil and gas contributing 14 percent and nuclear and others 32 percent (Staff Findings, at 6).

Moreover, even these recent projections may well prove to be conservative with respect to the future of coal in generating the nation's electricity. The most recent (March 1980) data of the Energy Information Agency indicate that in 1979, the respective percentage shares of the fuels generating electricity were: coal, 47.8; oil, 13.5; gas, 14.7; and nuclear/hydro, 12.5 (Monthly Energy Review, March 1980, at 60). In January 1980, the monthly

EIA data show that coal generated 51.3 percent of the nation's electricity.

The above estimates, moreover, were made based upon continuation of current national policies. Recent initiatives by the Administration are specifically designed to hasten the "back-out" of imported oil and gas, and would accelerate the trend to generate electricity from coal or alternate fuels. The success of such initiatives will proportionately increase the share of electricity generated from such plentiful domestic energy resources and, thus, enhance the desirability of increased reliance upon electricity in new construction.

The bias in the weighting factors against the use of electricity in new construction is thus a bias away from the use of energy generated from domestic energy resources, and towards continued reliance upon foreign sources of oil and natural gas.

> To the degree that BEPS favors oil or gas use over electricity, BEPS would be contrary to our domestic national energy policy of conserving scarce nonrenewable energy resources for their highest uses.

The virtually axiomatic policy of conserving nonrenewable resources for their highest use has been clearly expressed by the Congress in the Powerplant and Industrial Fuel Use Act (PIFUA, P.L. 95-620). There, Congress stated a national policy to conserve natural gas and petroleum for uses "for which there are no feasible alternative fuels or raw material substitute." (PIFUA, Sec. 102)

By encouraging the use of oil and gas and discouraging the use of electricity in new construction, BEPS would violate this sound national policy. There are significantly higher uses for oil and gas for which substitute fuels such as coal are not available or feasible. Such relatively scarce resources are clearly the most desirable fuels for certain essential agricultural uses, petrochemical feedstocks and industrial process hearing applications.

PIFUA also states a corollary to this principle of highest use, i.e., that more scarce fuels should be conserved. Thus, the Congress declared a policy to "conserve such gas and petroleum for the benefit of present and future generations." The nation's domestic coal supplies far exceed in Btu equivalency the nation's proven oil and gas reserves. Coal represents 81.7 percent of the known recoverable U.S. energy reserves, with petroleum representing 2.8 percent, natural gas and natural gas liquids 4.1 percent, and bitumins and shale oil 7.2 percent (Coal Data Book, President's Commission on Coal, February 1980, at 65).

The degree to which the bias in BEPS against electricity will affect future energy consumption patterns and supplies will be significant. Residential and commercial energy consumption in 1977 constituted 37 percent of domestic consumption. While this is projected to decrease slightly it will continue to represent more than one-third of all energy consumption in the 1985-1990 time frames. (Id., at 21) The impact of BEPS will fall upon all new construction within this sector. This impact will be increasingly large as new construction replaces old, or is undertaken in connection with future residential and commercial expansion.

Delivered electric energy derived from domestic reserves of coal is now and will continue to be available to substitute in the residential and commercial sector for the direct use of natural gas and oil in home hearing and cooling. BEPS would frustrate this desirable result.

The use of weighting factors biased against the use of electricity will maximize the economic risk to energy consumers.

Adverse economic impacts on the energy consumer are equally certain to occur from this bias in BEPS. On a cost per Btu equivalency basis, coal is and is likely to remain a significantly cheaper fuel than either gas or oil. This cost advantage will predictably be retained and reflected in the future price of electricity as regulated by state public utility commissions.

By contrast, the delivered price of oil and natural gas will rise dramatically with world oil prices and the repeal in 1985 of all federal controls on the price of natural gas.

We attach hereto a recent analysis by NCA of trends in the price of oil, coal, and natural gas delivered to utilities, for inclusion in the record of this proceeding.

The stated basis for the use of the proposed weighting factors is to reflect differences in life-cycle costs of new facilities based upon the source of the energy to be used, adjusted to reflect the relative national interest value in conserving different energy sources.

In fact, however, from an economic standpoint fuel choices can be most efficiently made at the powerplant level. Electricity is now and will continue to be generated by use of a variety of renewable and nonrenewable resources. As future fuel prices and availabilities change, powerplants and utility systems will be able to shift to the most economically efficient available fuel source or combination of sources.

By contrast, individual owners of residential or commercial buildings will have less flexibility. After initial design of a building, conversion to or from electricity, oil and natural gas will be more difficult. The energy consumer will thus be locked in to the original design choice, and subject to all of the resulting economic risks.

The methodology of identifying the weighting factors is deficient.

Finally, we note that the adjustment expressed in the weighting factors which is intended to take into account "explicit national policy determinations of non-market values associated with specific fuel types" merely replicates the "premium" previously established in connection with the federal coal conversion program. (Technical Support Document, "Weighting Factors," DOE/CS-0115, November 1979, at 1, 8.)

This "premium" has been adopted as "an approximate, but explicit, method for reflecting the impact of having to import more oil to meet additional consumption requirements." (Id., at 11) It is intended to

> "recognize in the same way as [PIFUA] that saving a barrel of oil is worth more to the Nation than what is reflected simply by its price." (Id., at 14)

As described by the draftsmen of BEPS, the premium derived in connection with DOE's PIFUA regulations is $7.13 per barrel of oil, or $1.29 per million Btu's, expressed in 1985 dollars. (Id., at 15. See also, discussion in Preamble to DOE Interim Rule, "Criteria for Petition for Exemption from Prohibitions of the Act," 44 Fed. Reg. 28955, in which this value is expressed in 1978 dollars as $2.25 per barrel of oil.)

This value has already been significantly challenged in major comments on the PIFUA regulations submitted to DOE by experts both within and outside the federal government. In fact, the projected world oil prices upon which the PIFUA premium was based are significantly lower than current projections, and in some cases lower than actual current prices.

Perhaps even more important, the economic value involved is significantly lower than that which the President recently determined would express the same economic effect when he decided to impose oil import duties of $4.00 per barrel.

Apart from these questions, the use of a premium derived for purposes of regulations under PIFUA is inappropriate in the context of BEPS. Specifically, the PIFUA premium does not attempt to quantify the value of decreased imports of natural gas. Moreover, it fails to take into account several economic and social issues which arise in the making of residential and commercial space conditioning choices.

The proposed premium would also fail to address the fact that if BEPS were to be adopted as proposed, future fuel supply shortages could result in significantly more severe dislocations in other national markets.

Anti-Conservation Effects of BEPS

The Conference Report on H.R. 12169, which became the Energy Conservation and Production Act, notes that

> (t)he energy conservation programs included in the conference substitute are intended to place needed emphasis upon reducing wasteful consumption without detracting from the nations (sic) continuing efforts to maximum domestic energy production.... It is estimated that the Federal energy conservation performance standards for new residential and commercial buildings, if fully implemented, will alone account for energy conservation savings of up to six million barrels per day by 1990. (Senate Conference Report No. 94-1119, August 5, 1976, at 52.)

The clear thrust of ECPA is to encourage the construction of more energy-efficient buildings. By contrast, BEPS would create economic incentives to building less efficient new structures.

As noted above, the weighting factors would penalize a designer proposing to utilize electricity for space heating and cooling. Specifically, under BEPS the designer could "use" the Btu's "saved" by using oil or gas for other purposes. Specifically, he might use a less efficient and less costly building envelope and still stay within his "design energy budget."

Moreover, BEPS would similarly discourage the possible use of innovative conservation technologies. The experience of one major coal-based utility system clearly demonstrates that such methodologies as electric storage heating can produce dramatic reductions in peak load energy usage. Where significant use of thermal energy storage devices is coupled with the availability of electricity at off-peak rates, for later use of the stored thermal energy during peak load periods, energy customers can achieve significant economic savings.

Further, allowing electric generating facilities to operate during off-peak periods at levels closer to their optimum output levels increases the efficiency of generation, and both energy and fuel savings are realized. A time-of-day tariff filed by the American Electric Power Company has been approved by the Public Utility Commission of Ohio, and the use of this innovative regulatory and energy storage technology shows great promise.

Such electric energy storage options would be discouraged to the degree that future applications of electric heating and cooling are discouraged.

Indeed, the adoption of a national standard (such as BEPS) which creates major disincentives to the use of electricity could discourage the use of heat pump technology, and undercut the rapidly developing concept of peak load pricing as a means of both conserving energy and reducing the cost of energy delivered to the consumer.

Finally, the use of a standard containing weighting factors such as those in BEPS will increase the cost of energy to all electricity consumers. The inability of utilities to use the most efficient load growth management and distribution methods will increase the marginal cost of electric service to all customers.

> BEPS will unnecessarily increase the cost of future construction through excessive administrative and regulatory complexity.

We note that the actual implementation of the standards set forth in the proposed rule making will remain to be developed in a rulemaking not yet released for public comment. We understand that DOE now intends to propose implementation regulations only after the adoption of final rulemaking to create the standards themselves.

We share the serious concern of many groups over this proposed course of action. The actual impact of BEPS in the real world will be determined in large part by the manner in which they are implemented. For instance, to the degree that DOE might elect to approve as "equivalent" a state building code that did not contain the deficiencies we have already noted in BEPS, the adverse effects on consumer costs would be reduced.

From the standpoint of the building construction industry, BEPS as now proposed are extremely complex. They will require detailed and sophisticated economic judgments and evaluations. In many instances, the use of computer modeling will be needed to determine the design energy consumption of a proposed building and its compliance with the applicable design energy budget. Such calculations are not now practical for application by many architects and engineers, and most building construction firms.

Even where the competence to make the determinations required by BEPS does exist, highly complex analysis would be required to make informed choices in future building design decisions. Separate calculations and comparisons in initial capital costs and operating costs over the life of the building would be required. These in turn will require estimates of future rates of inflation and future energy costs. Any errors in the data input to such calculations could result in design choices which, over the life of the facility, could impose severe economic penalties on the consumer.

Even if this were not the case, it is clear that BEPS will significantly increase the cost of future building design and construction. This will encourage the adoption of whichever methodology represents the apparent path of least resistance to the designer, i.e., the selection of fuel that will allow him the greatest latitude in meeting his overall building design energy budget. Thus, the result of BEPS could be to encourage the uninformed selection of fuels and insulation requirements that would be the most economic in terms o initial outlay, but most wasteful of energy resources.

We do not believe the actual probable economic impact of the adoption of BEPS has been adequately addressed in the Proposed Rulemaking.

> BEPS will unnecessarily jeopardize the ability of the states to implement the new program, and further frustrate the intent of the Congress in ECPA.

The stated intent of ECPA is to utilize existing state and local building codes to implement the energy conservation goals which it expresses, with a minimum of federal interference in state and local transactions. (ECPA, Sec. 302(a)(4).)

We are seriously concerned that BEPS are beyond the capacity of most state governments to implement, and would thus frustrate this Congressional intent.

In a recent review of this question, the General Accounting Office has noted that in many cases states will not be able to meet deadlines mandated in BEPS. This will mean that the states will be unable to certify, as required by ECPA, that controls at least equivalent to BEPS are in effect.

As a result, GAO concludes,

> "further federal actions, including the possible use of sanctions, may become necessary." (GAO Report, "Uncertainties about the Effectiveness of Federal Programs to Make New Buildings More Energy Efficient," January 28, 1980, Ch. 3, "Issues Affecting Building Energy Performance Standards Implementation," at 18.)

The clear intent of the draftsmen of ECPA was to have building energy performance standards implemented by the states. The sanctions that would prevent direct and indirect federal funding of construction in non-complying states were considered a last-resort approach, which under ECPA requires further Congressional action.

As now proposed, however, BEPS may have the effect of requiring such sanctions, by the very complexity of the proposed rulemaking. The major differences between the complicated requirements of BEPS and existing state mechanisms and procedures which might otherwise be used to implement ECPA, are noted by DOE in the NOPR (see, e.g., Sec. 5.0, "Implementation," at 44 Fed. Reg. 68156-80.) This could clearly frustrate the intent of Congress to place primary implementation responsibility in the states.

At the very least, GAO also points out, implementation by DOE of the state enforcement aspect of ECPA would require massive technical and financial assistance to the states. It would similarly create a substantial new federal bureaucracy.

SPECIFIC COMMENTS

In the Notice of Proposed Rulemaking, DOE has touched upon many of the substantive and procedural issues raised by BEPS. We are seriously concerned, however, that in so discussing the issues raised by BEPS and in the TSDs published to date DOE has not adequately discussed the single step which it might take to alleviate many of these problems: elimination from BEPS of the "source energy" concept and the "weighting factors" used to implement this unnecessary DOE initiative.

We have the following specific comments upon the NOPR. Section references are to the Preamble, and page references are to the Federal Register publication on November 28, 1979.

Section 1.1.2, "Summary Description of the Proposed Standards."

We note and concur with DOE's conclusion that ECPA defines the performance standards intended to be created as "energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed..." (44 Fed. Reg., at 68122)

We would point out, however, that this proscription by the Congress upon the promulgation of detailed federal methodology is in fact violated by that aspect of BEPS which incorporates economic disincentives to the use of electricity, and thus requires use of oil or gas.

We also note that all of the intended thrust of the Congressional mandate under which BEPS are to be created and described by DOE, may be fully met without inclusion of this aspect.

Section 1.3, "Elements of the Proposed Rule."

As will be noted again below, we strongly believe that the Appendices relating to "Approved Alternate Evaluation Techniques" and "Model Codes and Standards" have not yet been published. These and other as yet unpublished elements of the overall BEPS program (e.g., "administrative review," and procedures for the granting of exceptions) are critical to any meaningful evaluation of the actual impact of BEPS upon the federal government, state and local entities and the private sector.

Section 1.5, "Updating the Standards."

In view of the regulatory duration of the standards to be set by DOE and the magnitude of the impact of such standards upon the nation's long-term supply of new residential and commercial buildings, we strongly disagree that meaningful "updating" to accommodate deficiencies in data now available may occur. Any attempt at such "updating" would only increase dramatically the uncertainties and implementation problems already existing with respect to BEPS and may not be relied upon in a responsible rulemaking at this time.

Section 2.0, "The Research Effort."

We are concerned over the research previously undertaken by DOE in two respects. First, it represents a significant and substantial commitment of federal resources which will tend to generate a regulatory momentum in favor of proceeding with the BEPS program as designed by the draftsmen.

Second, a careful review of the research efforts already undertaken discloses that research has not been completed in a number of areas critical to informed final decisionmaking in this regulatory proceeding. The "new research" described by DOE as including "economic analysis, environmental analysis, life-cycle cost studies for single family residences, building classification analysis, weighting factor analysis, development of an evaluation technique and preparation of a [final] regulatory analysis" (NOPR, at 68124) should be completed before decisions that could have such far-ranging effects as BEPS are undertaken.

We also note that throughout the analysis undertaken by DOE to date, a clear distinction has been drawn in design energy analyses between "design energy requirements," or design energy estimates "at the site boundary," and the "design energy budget" and "design energy consumption estimates." (Id., at 68128, n. 9) It would thus appear that the actual research was directed at a regulatory mechanism which did not include the weighting factors used in reaching the values represented by the latter two concepts. We question whether, under these circumstances, the introduction of "weighting factors" at a later stage in rulemaking decicion would undermine the data or conclusions previously reached. The possible distorting effects of the later introduction of weighting factors would be particularly important with respect to the validity of the values reached in the "redesign" efforts which are the principal element in calculating the positive economic cost effectiveness of the BEPS program as proposed.

Section 2.2, "Research to Develop Energy Budget Levels."

DOE has concluded that separate evaluation was required for single-family residential buildings, which "departed significantly from that used for commercial and multi-family residential buildings." (Id., at 68132) The basis for this distinction is stated to be the absence of energy-conserving designs applicable to the smaller buildings, and the fact that "the economic analysis of the four prototypes and the energy conserving designs was not adequate as a basis for a proposed rule." (Id.)

We believe that considerations apply to each of the economic values assigned by DOE to the separate categories of building construction. We question whether the research to date is adequate as a basis for BEPS as now proposed, as discussed in more specific detail below. (See, e.g., the use of the Energy Information Administration Series B Midterm Price Forecast, originally set in 1977.)

In this regard we note also that among the "subjects for the continuing research effort in support of the final rule" is the "continued analysis of the economics and performance of heat pumps." (Id., at 68133) The use of heat pump and energy storage technology has a significant impact upon the relative energy efficiency of the use of electricity as the primary space conditioning medium. It is clear from the analysis set forth in the TSD "weighting factors" that inadequate review has been undertaken of this aspect of the bias in BEPS against electricity.

Section 2.3.1, "Environmental Issues."

We disagree with DOE's conclusion that because "no credit or penalty is currently given for design of a building with a lower or higher infiltration rate" the standards will necessarily "have no effect on the indoor air quality of single-family residential buildings." (Id., at 68134) Technical expert testimony submitted to DOE in its public hearings has indicated that this effect of BEPS could be major. It is inadequately considered in the proposal as now drafted.

In the same section, we also note DOE's recognition that "the economic parameters used in the life-cycle cost analysis may change" depending upon "the availability of reliable information." (Id., at 68136) This information includes fuel price projections which may be changed to use prices based on replacement energy costs, and the costs of energy conservation options which will be "based on the best information available at the time of the final rule." (Id.) Again, we feel that the inadequacy of the current state of DOE's data undermines the validity of its conclusions reached on life-cycle cost values. Since these conclusions are, in turn, the now stated basis for the actual calculation of the weighting factors, any deficiency in these data could have an important effect on the impact of the rulemaking.

Section 2.4.1, "Weighting Factors."

We strongly believe that the intent of the Congress in ECPA may only be fully implemented by the adoption of the first stated alternative for expressing proposed energy budget levels, i.e., expressing such levels "in terms of the energy content of the fuel delivered to the building site, with all weights set equal to one." (Id.)

As noted above, the continued use of weighting factors biased against electricity violates the intent of ECPA to encourage energy-efficient building construction, and runs contrary to other strong national policies relating to priorities in future fuel use. While many of these priorities were established subsequent to ECPA, nothing in ECPA prevents their full recognition and implementation in the proposed rulemaking.

With respect to the specific discussion advanced by DOE, we note that all of the uncertainties and difficulties described by DOE as valid against the use of the approach contained in the ANOPR apply as well to the use of the weighting factors now proposed. For the same reason that DOE has rejected the use of Resource Utilization Factors and Resource Impact Factors, the weighting factors should be rejected as well.

We very strongly disagree with DOE's rejection of alternative one, on the basis that it "ignores energy losses in the conversion of an energy resource into a useful energy form." (Id., at 68137) ECPA is not directed towards energy losses in conversion from fuel to energy. Other federal policies separately address the national priorities appropriate to consideration of these questions, which have been well expressed by the President in the National Energy Plan:

> To the extent that electricity is substituted for oil and gas, the total amounts of energy used in the country will be somewhat larger due to the inherent inefficiency of electricity generation and distribution. But conserving scarce oil and natural gas is far more important than saving coal. (NEP, at xii-xiii.)

We do not agree that the current DOE approach to use weighting factors "that explicitly account for the cost of fuels and the value to the Nation of conserving different fuels" is valid. As noted above, weighting factors derived from life-cycle cost analyses are based upon outdated data. Similarly, the "premium" assigned by DOE to reflect the national interest in conserving certain fuels is outdated, and has been superseded by the President in his assessment of that value for an import duty on foreign oil designed to reflect the same economic and political judgments.

The impact of the distortion thus introduced by the weighting factors will fall disproportionately across the nation. In this regard, the use of a national aggregation of fuel mixes does not adequately express the adverse impact of BEPS. In fact, the adverse economic and energy impacts will fall primarily in those areas of the country in which coal or nuclear resources are used to generate electricity against which BEPS would be biased. DOE has undertaken no substantial analysis of the geographical distribution of such impacts, and the adverse impacts on housing and commercial construction starts by geographic area.

In this regard, we do not believe it to be a responsible answer to this question to simply confess that "insufficient regional data was available to development regional weighting factors." (Id., at 68138)

Similarly, we do not believe that the DOE can proceed with rulemaking upon the assurance that "should the ongoing research identify serious inequities in this approach, appropriate modifications will be considered for the final rule." (Id.) The use and impact of weighting factors is the single most critical element in the proposed rulemaking. It will define the actual adverse impacts on an area-by-area basis, and will in large part determine the ability of the states and local governments to conform to the federal program. This data inadequacy is thus at the heart of the rulemaking, and must be fully satisfied before final decisionmaking is undertaken.

We concur with DOE's conclusion that "many designers are accustomed to thinking about energy use in terms of the energy required at the building boundary." (Id.) We disagree, however, that this concern may be dismissed summarily as merely requiring education or training of implementation personnel. The inescapable fact is that the approach taken in BEPS is radically different, in ways not required by ECPA, from the methodologies now used in building design and enforcement of building codes and permit mechanisms. Its retention in final rulemaking is the source of virtually all of the major substantive and procudural (as opposed to technical) problems with BEPS as now proposed.

In light of the data inadequacies previously identified, we do not understand how DOE can conclude that

> "most of the basically well-designed buildings that would be in compliance with a Design Energy Budget where all weights were equal to 1.0 (i.e., site-based) would also be in compliance with a Design Energy Budget where the weighting factors were derived by DOE as noted above, and with RUFs as well." (Id., at 68141)

The display set forth at Table 2-2 (Id., at 68140) clearly demonstrates the actual impact of the weighting factors upon energy budget levels. For DOE to conclude that no problem is presented by the use of weighting factors because well designed buildings will meet energy budget levels is to ignore the real question: the fuel choices and economic consequences that will be required to be made because of the level at which such budgets are set. The major problem with BEPS is not alleviated by the summary conclusion that budgets may be met, for the problem arises from the manner in which BEPS would in fact compel design choices. The precise problem with BEPS is described in the NOPR concisely: the choice of weighting factors will influence the mix of fuel types saved. (Id.) Regardless of the theoretical basis now advanced for the use of weighting factors, their effect will be precisely the same as those unacceptable effects which would arise from the use of the abandoned RUFs and RIFs: mandated fuel choices beyond the intent of the Congress and contrary to sound national policy.

Section 2.4.5, "Climate."

The impact of climate variations is recognized in BEPS by reference to the use of 78 Standard Metropolitan Statistical Areas (SMSAs). The methodology whereby SMSAs would be related to actual climate conditions, "either by proximity or by similarity in weather characteristics to one or more of these 78 SMSAs and cities" (Id., at 68145) is unclear. We suggest that any BEPS program should utilize actual climatic conditions, without extrapolation, to ensure that appropriate is given to the realistic limitations of energy conservation technology.

Section 3.0, "Selection of the Proposed Energy Budget Levels."

We concur that any program to implement ECPA through building energy performance standards "should accelerate the use of energy conserving and renewable technologies to the maximum extent practicable." (Id., at 68146)

For the reasons set forth above, we believe that the bias in BEPS against electricity would frustrate achieving this purpose. It would, instead, provide an economic benefit based on fuel choice which would allow the use of less energy conserving technology. It would discourage the promising energy conserving technologies usable only through the mechanism of electrical-based devices and should be rejected.

We concur with DOE's conclusion here also that the "unfamiliarity of design professionals with energy-efficient design strategies and available technology" would be a "major constraint in the design of more energy-efficient...buildings." (Id., at 68147) We do not concur that this "aspect of practicability" is a strong deterrent against only the "very strict" energy budget levels. We believe it should be viewed as a strong deterrent against adoption of the approach taken by BEPS as now proposed.

The degree to which the Energy Budget Levels set in BEPS would change or adversely impact current technology and enforcement mechanisms is clear from the range of design energy reduction levels which DOE identifies would occur under BEPS as compared to the proposed component performance standards set forth in ASHRAE 90-75R and the draft version of the HUD minimum property standards now pending.

In addition, we also note the magnitude of the changes which DOE was required to make in the ASHRAE standard to increase its stringency to levels approximating "equivalency" for the proposed Energy Budget Levels. (Id., at 68148) It is clear from the magnitude of these necessary changes that current methodologies and practices, and performance levels set in existing mechanisms, are not now equivalent to the levels set in BEPS.

This degree of difference is especially critical with respect to the ability of states and the private sector to bring their current practices into conformity with BEPS. While we concur that DOE should evaluate the changes made to increase such stringency "for technical feasibility and practicability," (Id.) we believe that the dimensions of difference preclude final rulemaking to establish

Energy Budget Levels at the proposed degree of stringency at this time.

Section 3.3.2, "Economic Impacts."

Because of the bias and inherent uncertainties introduced into the setting of the proposed Energy Budget Levels by the use of the weighting factors, we believe DOE's conclusions as to the economic impacts cannot be considered valid. The dependency of the actual first cost increases upon the condition that "the designer is familiar with cost-effective ways of achieving a lower Design Energy Consumption" not only undermines the conclusions reached by DOE on the ranges of such costs, but begs the critical question of fuel choice bias introduced by the weighting factors themselves.

While we concur generally that the use of life-cycle cost analysis is appropriate to determine levels of energy conservation, we believe that such analysis should include only the economic considerations relevant to the building site. The weighting factors are derived from external economic and policy considerations and are accordingly invalid as an element in the determination of true life-cycle costs for an individual consumer.

For the reasons stated above, we strongly disagree with DOE's dismissal of environmental impacts on the grounds that the propose standards give no credit for reduced air infiltration rates. (Sec. 3.3.5) While no credit is given, in fact, the achievement of Design Energy Budget compliance if electricity is the fuel of choice will require significantly reduced rates of infiltration and resulting adverse environmental impacts on indoor air quality. It is imperative that DOE analize this effect as one of the negative impacts which will arise if the use of strongly biased weighting factors is retained.

Also, as noted above, we disagree that the effect of BEPS will be to encourage the "development and implementation of new design approaches." (Sec. 3.3.6, at Id., 68150)

Section 4.0, "Building Design Evaluation Techniques."

In this section of the Preamble, DOE discusses the alternatives for evaluation of building design in a BEPS program under ECPA. We believe that this discussion and the more elaborate explanation contained in TSD No. 1, "The Standard Evaluation Technique," demonstrates that the private sector will experience considerable difficulty in attempting to determine compliance with the standards set in BEPS and the resulting regulatory implementation mechanisms. The extensive reliance upon the use of computer programming (and the relative absence of consideration given to manual calculations such as are presently utilized) appear to be beyond the economic and technical capability of the construction and design industry.

The availability in the public domain of programs such as DOE-2, TRNSYS, and DEROB is not an adequate response to this problem. There has been no adequate analysis by DOE of the actual economic and technical limitations of the industry, and the dimensions of the governmental support that will be required at the federal level if this complex methodology is retained as drafted.

The alternative to use of the standard evaluation technique, described by DOE as "alternate evaluation techniques," would in fact have to be relied upon in implementing BEPS. While we may concur that it is "in the public interest that additional computer and "manual" energy calculation methodologies be established as alternate evaluation techniques on a national basis," (Id., at 68154) we believe it would be irresponsible as a matter of public policy for DOE to adopt a BEPS program which in fact is dependent upon the use of such alternatives. Expert testimony from the industries involved indicates that this would be the necessary result if BEPS are promulgated as drafted. No regulatory program should be promulgated which at the outset is on its face unworkable. Even if it were true that "a wide variety of energy calculation methods will be developed to determine a building's Design Energy Consumption that will yield results consistent with the Standard Evaluation Technique" (Id., at 68155) no standard should be promulgated which is dependent upon such future development. This is especially true where, as in BEPS, the effect of inability to comply with a federally mandated program will result in such drastic sanctions.

Section 5.0, "Implementation."

In this section, DOE sets forth its assessment of the probable issues and problems that will be addressed in implementation regulations.

As noted above, we believe that any informed analysis of BEPS must await promulgation of these regulations.

The impact of adopting BEPS in advance of implementation will be significant. BEPS will be required to be implemented immediately in federal programs, regardless of whether later approval by Congress of sanctions applicable to states occurs. (Id., at 68157)

We believe DOE to understate the degree of federal assistance that will be required to implement BEPS. The inability of states and the private sector to adopt to the radically different standards now proposed will require virtual federal preemption of the entire program with resulting budgetary, personnel and bureaucratic and inefficient delays.

Moreover, we believe that the DOE has failed completely to address the issue of potential liability of design professionals in the event that their certification of compliance by a proposed building becomes the determining factor under an enforcement program. DOE has noted in its Draft Environmental Impact Statement that general liability insurance "is available" to contractors (DEIS, at 3-41) but has nowhere addressed the question of whether and at what cost liability insurance may be available to professionals upon whose judgment states and local governments and individual builders and owners will be required to rely. In view of the potential adverse consequences if such determinations are later challenged, it would appear that liability insurance of an entirely new scale of magnitude would be required before design professionals could possibly undertake this additional responsibility.

The availability of this mechanism is central to implementation of BEPS, and the absence of any material consideration of this issue jeopardizes the entire implementation discussion of the "Alternate Approval Process." (Sec. 5.4.2, Id., at 68159)

CONCLUSION

Final rulemaking on BEPS should be deferred at this time. At a minimum, data deficiencies identified by DOE and commentators must be completed, and final rulemaking on the implementation of the proposed program formally proposed.

In final rulemaking, the "weighting factors" aspect and the "source energy" concept embodied in BEPS should be deleted. Building energy performance standards should be imposed based upon energy consumption on the site.

Only by incorporating such amendments in final rulemaking can the DOE fully implement the intent of the Congress in ECPA, and comply with the national policy set by the Congress and the President with respect to future fuel use.

APPENDIX XI

Written Comments of Gerald Mara and Joan Shorey for the Center for Renewable Resources, Apr. 30, 1980; and Testimony of Bruce Anderson, Chairperson, Office of Conservation and Solar Energy, Mar. 27, 1980

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April 30, 1980

Written Comments of
Gerald Mara and Joan Shorey
for the Center for Renewable Resources
on the Proposed Rule for Building
Energy Performance Standards

I. INTRODUCTION

The Proposed Rule for the Building Energy Performance Standards is an ambitious, controversial attempt to control energy consumption in new buildings while allowing America's designers and builders to retain the flexibility and innovativeness essential to a competitive and diverse industry. Accordingly, the rule and its technical support documents are multifaceted, they represent both regulatory and research efforts. The dual purpose and approach have spawned numerous criticisms of the rule, some of which has been justified. Nonetheless the Center for Renewable Resources, holds that the rule provides us with a necessary and, if implemented rationally, a plausible means for reducing energy consumption in new buildings. To reiterate the major point made in our oral testimony, all of the technical problems in BEPS are correctable and none provides DOE with a valid excuse for failure to implement the standards as promptly as possible.

However, the Standards could do far more than they currently do to encourage the use of renewable energy in buildings. They contain technical problems and practical

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uncertainties that need resolution. Their adoption must be accompanied by the development of a research agenda that will guide future technical analyses and a rational plan that will allow for fair, effective implementation. Given these needs we will devote most of our written comments to the enumeration of some of the technical and practical problems that need further consideration, and will propose an agenda for research and implementation. In passing we will occasionally comment on some relevant issues raised in the public hearings. As we did in our oral remarks, we will concentrate here on issues connected with the treatment of renewable resources in the Standards, recognizing the interdependence of renewable and energy conservation measures in all energy-efficient building design.[1]

II. PLACE OF RENEWABLE ENERGY IN DESIGN ENERGY BUDGETS

Include Solar In Design Energy Budgets

Even though ECPA specifically required the Standards to encourage the use of renewable energy, the rule does not adequately promote this goal. BEPS depends on the ingenuity of individual designers to take advantage of the energy "credits" it offers. Yet, the design energy budget levels are not strict enough to encourage many designers to consider solar energy options. The one express attempt to encourage the use of renewables is the inclusion of hot water loads in the design energy budget levels. Even here, however, builders are allowed to credit the conventional energy saved by solar water heating to the design energy consumption in the rest of the building. In effect, designers are encouraged to combine solar water heating with more energy consumptive buildings. While the attempt to stimulate the use of solar energy for water heating is laudable, Congress certainly did not intend that DOE should encourage the use of renewables at the expense of energy conservation. As noted in our oral testimony, this problem is compounded by the use of hot water budget levels that may be too high. We are not convinced that the supposed 50 percent share of the total heating and cooling load for hot water is accurate even using heating and cooling loads reduced by BEPS.[2] Nor do we believe that the range of temperatures from design inlet 50° F to design outlet 140° F, noted in TSD #3, I-1, is reasonable as a national average figure.

Additional Research Needed

Rather than encouraging the use of renewable energy simply by including hot water loads in budget levels, we suggest that the overall design energy budget levels be reduced to reflect the substantial potential contribution of renewable energy to meeting both space conditioning and water heating requirements. This should be done immediately. But given the technical and practical difficulties involved in initiating this change now, we recommend that research aimed at reducing design energy budget levels be initiated as soon as possible, along with the publication of a reasonable updating schedule and the development of the compliance tools discussed in TSD #7 - Supplement.[3] Such a research effort is needed not only to redress the Standards' failure to treat solar energy adequately, but also to correct some of the glaring deficiencies in the analysis of energy conservation.

Single Family Analysis

Toughening design energy budget levels for single family houses should be done with all deliberate speed after the rule is promulgated. At a minimum, such an effort would include the following steps in making revised design energy budget calculations:

- Recognizing the potential contribution of solar energy for both water heating and climate control. This potential was not included in the current research effort (cf. F.R. 44, 230, p. 68135) even though the separate Passive and Active Solar Heating Analysis (TSD #9) found passive solar to be economically competitive in nine out of ten representative cities.[4] DOE should also note that passive solar energy is a Program Measure in all regions of the country in the Residential Conservation Service (RCS) Program.
- Reducing assumed thermostat settings for heating from 70° F to a minimum of 68° F. While this may seem trivial, we find it unbelievable the DOE's research effort is out of step with its own consumer education campaigns.
- Do not assume that all homes use air conditioning if the inside temperature exceeds 78° F and methods of natural ventilation fail to reduce it below that level. At a minimum, some kind of empirical research ought to be done on the number of new houses built with central air.
- Including variations in furnace sizes in life cycle cost analyses, if realistic. The economics of many solar and energy conservation measures may improve noticeably if furnace sizes are allowed to decrease as loads are reduced or alternative energy sources used.

Solar/Conservation Analysis

This proposed research effort would require the development of a better mechanism for analyzing combinations of solar and energy conservation techniques. The methodology used in TSD #9 seems seriously defective. Most damaging is its treatment of solar energy as an add-on or supplement to various levels of energy conservation design, rather than as an integral building design in its own right. We have not done the technical work needed to show how this methodology should be constructed. But by enumerating some of the current deficiencies we wish to emphasize the general need for further refinement.

- The analysis does not pay enough attention to passive solar energy systems and to the consequent changes needed in conventional houses to make those systems function economically. For example, no reduction of glazing in north or west walls below 15 percent of the wall area is allowed.[5] However, good passive solar design generally requires reduction of glazed areas on north walls. As TSD #9 (p. 4-2) notes, the costs of passive systems can be reduced by "moving" glazing from north walls to south ones. However, although mentioned in the TSD, this strategy is not included in the life cycle cost analysis of passive systems.
- The analysis of direct gain systems only, particularly allowing only 4-inch slab-on-grade foundations, would seem to prevent a comprehensive evaluation of passive storage and distribution systems. Additionally, it is

stated that the use of internal mass walls would double costs of direct gain systems.[6] However, it is not indicated whether a consequent reduction in normal internal wall costs was deducted from the analysis of passive construction costs.

- Passive solar cooling is not considered.
- Many of the assumptions used in the active and passive solar analyses need to be evaluated. For example, the costs of competing fuels, especially critical for evaluating the economics of hot water systems, should reflect current predictions for non-renewable fuel price escalation.

These considerations suggest the need to develop a way of analyzing solar energy contributions to buildings that is integrated with the overall BEPS research methodology. This integration must begin with a more realistic assessment of current energy-conserving building practices, including current developments in active and passive solar design. Several witnesses at the public hearings made this identical point[7] and we suggest that DOE use the information supplied by them and by other experts to supplement or verify the assumptions of its more formal BEPS research.

We believe DOE has been too conservative in its assessment of the feasibility of solar for widespread use. Some form of "solar" energy, including energy-conscious siting, earth sheltering and effective placement of glass and overhangs, is possible in a vast majority of new houses. Those relatively few designs unable to use any solar features for climate control could meet stricter budget levels simply through the use of additional energy conservation techniques. More important, tougher BEPS would encourage the efficient use of site as well as building design. Many energy efficient site design techniques are well known to builders now.[8] Stricter BEPS would simply provide additional incentives to use them.

Multifamily Housing

Substantial problems surround the multifamily budgets for both low-rise and high-rise buildings. Indeed, unless the errors are corrected as soon as possible, the Standards will not have any effect on this sector. This area is particularly important for encouraging the use of renewable energy since solar hot water can be used very effectively in multifamily buildings. However, current design energy budget levels for multifamily structures are so high that they will do little to encourage either use of renewables or energy conservation in those structures.

Multifamily residences built now are likely to house many lower income persons, most of them renters, over the long term. Low-income renters have little incentive and money to make energy conservation improvements in their dwellings. At the same time, they are the people most seriously hurt by high energy costs. Current BEPS budgets for multifamily housing virtually guarantee that policy dilemmas over strategies to encourage energy conservation in rental housing will continue into the next century.

Therefore, the Center strongly suggests that the BEPS multifamily analyses be redone, if possible, prior to the promulgation of the Standards. The analysis should depart from the "building survey" method used in the current version and instead follow the life cycle method with prototype buildings that was used for setting single-family budgets. As it stands now, the analysis seems to treat multifamily buildings too much like commercial buildings, assuming for example a much higher level of lighting (and thus weighted electricity use) than is reasonable.

III. ADDITIONAL ISSUES RAISED AT PUBLIC HEARINGS

Of the many questions raised by witnesses at the public hearings, two strike us as being particularly important: the treatment of user operated energy devices and the use of weighting factors.

User Operated Devices

Many people have suggested that DOE should consider more effects of user operated devices in setting budget levels.[9] DOE currently assumes that some user controls will be applied, like the use of air conditioning, but ignores others, like the use of night setbacks on thermostats. Others say that doing so would allow room for the design crediting of "phantom" savings. For example, a designer could assume that an occupant would set back the thermostat from 70° F to 62° F from 11:00 p.m. to 7:00 a.m. during the heating season and then use the design energy saved by that setback to meet an increased design load in some other part of the house. However, if the resident neglected the setback, the actual energy consumption would be that much in excess of design. Wariness about this sort of abuse has apparently dissuaded DOE from including the effects of most user operated devices in setting design energy budgets.

The Center contends that user controlled savings should be encouraged by the Standards. User actions are particularly important in the operation of some passive solar systems. Since we also agree with DOE that paper savings from user devices should not be used to lower design energy consumption artificially, we suggest that DOE include studies on the effectiveness and the predictability of use of different user operated devices in its future research efforts with a view toward including those results in the revised Standards.

Weighting Factors and Renewable Energy

The weighting factors have often been critized as attempts to set national fuels policy under the guise of building performance standards. Many such objections seem based on symbolic, not substantive, grounds. We believe the weighting factors are indispensable if the costs of competing fuels are to be included in BEPS-motivated choices of renewable energy techniques. Solar energy appears to be currently more competitive economically against electricity than gas. The use of weighting factors simply assures that that competitiveness does not disappear in the energy budget levels. With an effective weighting factor of 1.0 for all fuel types, a solar water heater or passive design would appear no more attractive from a BEPS standpoint compared to electricity than compared to gas. However, the present weighting factors used in the NOPR will make solar and other efficient substitutes for or supplements to electricity particularly appealing.

More important, the weighting factors serve as means to drive current technologies, including more efficient combinations of renewable and non-renewable supplies, toward greater efficiency. For example, the weighting factors reward the use of more efficient heat pumps. The use of solar energy in combination with heat pumps will result in higher seasonal coefficients of performance for many heat pump configurations in colder climates. This technology requires further development and the use of weighting factors within BEPS provides an added incentive for such advances.

Accordingly, we recommend that DOE retain the weighting factors in the final rule on condition that they be adjusted for current fuel prices before promulgation. For example, the weighting factor for oil should probably be higher than its current level of 1.22.

IV. IMPLEMENTATION AND SANCTIONS

Implementation

The implementation of the Standards will ultimately determine their success or failure. Currently, questions about implementation are linked with questions about possible sanctions. However, we believe it is important to keep the two separate; we suggest that an effective implementation strategy can be developed prior to or even in the absence of a program of formal sactions. In short, effective implementation need not be delayed be debates over appropriate sanctions.

DOE has recently issued a supplement to TSD #7 that discusses implementation extensively. We believe this is a careful, well thought out piece of work. Regrettably, however, this document was not made available to the public prior to the hearings. We thus urge DOE to invite widespread public response to this document, especially from those most likely to be affected, prior to making any final decisions. Since the details of the report are so complex and since we anticipate opportunities for further comment, we will confine our observations to some fairly general remarks.

As DOE recognizes, the surest and most effective means of implementing the Standards are to adopt prescriptive equivalencies on the state and local levels and to begin a vigorous technical assistance program. Even then, adoption takes time. Recognizing this, DOE has suggested general guidelines for an alternate approval process (AAP) to be used until or in the absence of the development of a formal certification process.

However, neither process will be successful or attractive unless the full range of tools outlined in section 3.1.3. of TSD #7 - Supplement is developed with care and speed. This shopping list of resources is impressive and reasonably complete. But, frankly, we would like to see more evidence that they are actually being prepared and, if they are, that they reflect the knowledge and experience of practicing builders and designers. It is essential that these tools, especially the Manual of Recommended Practice, include information on various renewable energy options. To our knowledge, no one in the HUD Solar Demonstration Program has been consulted on any of these products. If not, this is a serious oversight that needs immediate correction.

Sanctions/Incentives

Questions of sanctions cannot be discussed intelligently unless the long lead time needed to develop information tools, model perscriptive equivalencies and alternative approval processes is appreciated. Necessarily the development of assistance tools comes first. Indeed, it should be going on now. We believe it is premature to discuss sanctions, except generally, until many of these preliminary tools and programs are in place. However, we do have some general observations.

First, we suggest that an incentives only strategy be followed until many formal certification processes are in place. Applying formal sanctions when only AAPs are functioning seems both unfair and unworkable. Of the incentives listed in TSD #7, grants and technical assistance programs strike us as the most effective. We encourage DOE to begin planning to provide these now and, again, to use existing practical expertise to develop these tools. Applied research and development efforts would be useful providing conditions sufficiently resembled real world situations and were tied to an overall technical assistance effort, rather than implemented separately. An effective public information program would be useful if related to the technical assistance effort. However, the tax credit strategy threatens to be time consuming, possibly inequitable and administratively cumbersome. Spending time on this when it could be used to develop technical assistance programs does not strike us as being particularly productive. The tax reform strategy applies to an overall deficiency in the tax code which sould be remedied apart from any initiative to implement BEPS. In fact, the tax reform program should have its greatest impact on existing buildings. We encourage DOE and Congress to pursue this tax reform effort, but we do not believe it should be tightly connected to the implementation of BEPS.

Second, the sanctions strategy should be kept open but actual decisions on the scope and extent of sanctions should be deferred until we have enough experience with voluntary compliance. Only then can a rational decision on sanctions occur. It should be recognized that even without sanctions, the standards will have extensive impact. They will apply to all Federally-assisted housing relying on the Minimum Property Standards. Given the widespread use of the MPS as a model in the private market, BEPS can potentially leverage a significant portion of privately financed stock as well. We suggest that DOE recommend that Congress defer decisions on formal sanctions until more is known about voluntary compliance in the marketplace.

Third, if sanctions are needed DOE should give more thought to their structure and scope than is currently evidenced. The range of options is more sophisticated than the three alternatives listed in 3.1.2.2. of TSD #7 publicity, administrative action and criminal prosecution. The administrative sanctions are meant to be a rational compromise between publicity (too lenient) and criminal liability (too harsh). However, what is really needed is to clarify the range of sub options within the administrative option itself. DOE begins to do this by distinguishing between those sanctions that would leverage decision makers and those that would not. DOE should, however, go farther It should clarify its options and their projected impacts beyond what is expressed now in TSD #7 - Supplement.

Monitoring

Finally, we would like to underscore the need for monitoring the actual energy consumption in samples of BEPS buildings as part of the ongoing BEPS research effort. This is not, and should not be, an effort to police the building industry. But it will allow DOE to determine how well the standard evaluation technique matches reality. This kind of effort is critical if DOE is to be sure that savings on paper are an adequate guide to savings in practice.

V. SUMMARY

We suggest the following general research and implementation activities be undertaken.

Pre-Promulgation

- Develop and announce research agenda.
- Publish updating schedule.
- Begin developing tools to encourage compliance.
- Revise multifamily budget levels.

Promulgation - Effective Date

- Begin research effort aimed at stricter BEPS with particular emphasis on including renewables in revised BEPS budgets.
- Disseminate information on tools to encourage compliance, including Manual of Recommended Practice.

Post-Effective Date

- Apply incentives only strategy to encourage compliance.
- Begin evaluation of sanctions options.
- Develop tougher BEPS that include renewables.

- o Monitor compliance to see if sanctions are needed.
- o Monitor actual energy consumption to determine BEPS effectiveness.

VI. CONCLUSION

The recommendations outlined above are challenging. But we believe they are consistent with Congress' intent and DOE's commitment to include renewable enregy considerations in sound BEPS. We would like to emphasize again that both our criticisms and our proposals do not reflect a lack of support for the prompt implementation of the Standards or a lack of appreciation for DOE's efforts up to now. BEPS as they are constitute a positive step toward reducing energy use in this country. Suitably revised and corrected, the Standards can encourage the inclusion of both energy conservation and renewable resources in our nation's buildings.

NOTES

1. Gerald Mara and Joan Shorey, Testimony of the Center for Renewable Resources on the Proposed Rule for the Building Energy Performance Standards, March 27, 1980.

2. cf. Federal Register 44, 230 p. 68135.

3. pp. 3-10 -- 3-12.

4. pp. 2-28 -- 2-29

5. TSD 9, p. 2-4

6. Ibid p. 2-8

7. Bruce Anderson, Testimony of the Solar Lobby, March 27, 1980; Grant Thompson, Testimony of the Conservation Foundation, March 25, 1980; See also BEPSGRAM, Let the Sun Shine In, April 9, 1980.

8. cf. Martin Jaffe and Duncan Erley, Protecting Solar Access for Residential Development: A Guidebook for Planning Officials, Washington, D.C.: HUD, 1979.

9. See for example David Knepper, Testimony of Rural America, March 27, 1980; Merrill Butler, Testimony of the National Association of Home Builders, March 24, 1980.

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March 27, 1980

Testimony of

Bruce Anderson, Chairperson

Before the

Office of Conservation and Solar Energy,

Department of Energy

Mr. Chairman, members of the committee, ladies and gentlemen:

My name is Bruce Anderson. I am today, as chairperson, testifying on behalf of the Solar Lobby, a research and advocacy group with offices in Washington, D.C. and a membership of over 35,000 people in all walks of life. I am also testifying as a building industry professional, fully active in the use of conservation and renewable energy in buildings. I have architecture and engineering degrees from M.I.T. and am founder and Chairman of Total Environmental Action, Inc., a building, research, design, engineering, and education firm of thirty professionals in Harrisville, New Hampshire. T.E.A. has been involved in hundreds of low energy, solar buildings of all types since 1973. I am co-founder and Executive Editor of Solar Age magazine, which emphasizes conservation and solar energy in buildings. I have written several books on energy conservation and solar energy in buildings, most recently (with Douglas Balcomb), DOE's Passive Solar Design Handbook.

Objectives of Energy Standards

My concern for the use of energy in building reflects many points of views, including those of a homeowner, an architect, an engineer, a builder, an advocate, and a public policy-maker. My concern also transcends the desire simply to decrease energy consumption. The Solar Lobby's concern in formulating BEPS has roots in five national goals:

1. reducing consumption of and dependence on dwindling, expensive, and unhealthy energy resources;

2. decreasing our dependence on foreign oil;

3. building and maintaining a strong and healthy

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building industry;

4. developing our country's non-depletable, naturally renewable energy resources; and

5. improving the welfare of our citizens by enabling them to spend less on energy, by reducing inflation, by creating more and better jobs, by improving the quality of housing, by cleaning up the environment, and by preserving the democratic ideals upon which this country stands.

Following naturally from these goals, our testimony today will focus on the following points:

First, if properly developed and implemented, strong and enlightened BEPS can contribute to national energy and social goals.

Second, the levels of energy consumption as presently proposed by BEPS can be achieved today without further study and without further technological or product development.

a. Energy consumption levels (for heating, cooling, and hot water heating) approaching zero are achievable for houses in the most severe climates (For example, see "100-Percent Solar in a Severe Climate" in Solar Age, May 1979, an account of a 2000 square foot house in Saskatchewan (11,000 degree days) that uses only solar energy and heat from the occupants and from the internal use of electricity.).

b. Building design need not be revolutionized to achieve energy efficiency. Slightly thicker walls, tighter construction, and additional layers of glazing are all that are required in most cases to meet the proposed Standards in residential construction.

c. No advanced technology or products are required to meet the Standards. Conventional (or easily modified) construction techniques are adequate.

d. Properly applied, the increased cost of meeting the Standards is more than offset by the energy savings, and the net cash flow to the homebuyer is substantially positive beginning in the first year of ownership.

e. The quality of our building stock will be measurably increased as a result of the Standards.

f. Implementing the Standards immediately will result in immediate energy savings, even as additional efficiency improvements are being developed and put into practice and as the Standards are improved and strengthened.

Third, passive and active solar designs and applications work today (particularly if care is taken to use them properly) and are commercially ready. They are understood by large numbers of people and are available throughout the construction industry. But both government and the private sector must make a commitment to integrate solar energy with conservation measures if energy consumption is to be reduced to economically and politically acceptable levels. A proper mix of energy conservation and solar heating and cooling can reduce space conditioning energy consumption in many building types to less than 5-percent of pre-oil embargo (1973) average consumption levels and to less than 10-percent of current levels. The proposed Standards will reduce energy consumption to levels where they should have been prior to 1973. Although they are a step in the right direction, they are still woefully inadequate when compared with present day realities of energy price and supply and when compared with other alternatives.

Fourth, to assure widespread acceptance by homeowners and other building-owners, parallel mechanisms for financing higher building costs must be provided.

Fifth, a major education and training effort of all segments of the construction industry must parallel the implementation of these Standards.

Sixth, simplified design evaluation procedures must accompany the careful phasing in of more stringent standards in the future.

Seventh, a major continuing effort to improve and update the Standards must be made, while at the same time making them more palatable to the building industry. Close monitoring and evaluation should provide feedback for use in updating and revision. The standards must be simplified and must be made more responsive to rises in energy prices, to decreases of energy supplies, and to the instability of the overall national energy picture.

Background

These recommendations reflect experience as well as common sense. During the past seven years, hundreds, even thousands, of buildings have proven that heating and cooling energy consumption can be reduced to 5-percent (or less) of pre-oil embargo levels. In fuel bills, this amounts to five cents or less per square foot of floor area in residential construction for space heating and cooling (or $100 per year for a 2000 square foot house). For large commercial buildings, the annual bill for all energy uses can be less than fifty cents per square foot. Building owners benefit greatly from these low energy budgets: their annual energy savings will exceed the amount of the mortgage increase that is due to higher construction costs.

Properly designed low-energy buildings noticeably improve living and working conditions. For builders, the financial advantages are obvious. Higher-cost buildings mean, under normal circumstances, higher profits. For architects and engineers, energy-conscious design offers new creative, professional opportunities. For financing institutions, an investment in a low-energy building makes better business sense than an investment in a leaky one. For building materials suppliers, it means greater sales.

The members of these segments of the construction industry are, in most cases, also homeowners. Most of them are aware that stringent conservation levels are possible, right, and proper, just as in our private roles, high-energy buildings are unacceptable to consumers and the Nation as a whole. The Energy Mobilization Board, nuclear power, synthetic fuels, coal, imported oil, and development of our overstrained domestic oil and gas supplies -- all the alternatives to low-energy use -- are either far more expensive than low-energy buildings, far more difficult to implement, more environmentally malicious, more controversial, or more financially risky.

While debatable in part, this consensus is not far from the mark. Why is it, then, that the Building Energy Performance Standards, as proposed, are meeting with such universal criticism?

Goosebrook: An Example

To help answer that question, let me use as an example a house designed, built, and sold by Total Environmental Action, Inc. The house, referred to as Goosebrook, is located in southern New Hampshire in a climate of 7500 degree days and average sunshine. The three-bedroom home totals 1,450 square feet. In addition, it has a 700 square foot basement, a front entry and a 100 square foot greenhouse (both serve as airlocks at the two entrances), 350 square feet of outdoor deck, and a two-car garage. Situated on two acres of land, Goosebrook cost $70,000 in 1977.

The basement foundation walls are insulated with three inches of styrofoam. The walls are 2 x 6 studs (24 inches on center) filled with R-19 fiberglass and sheathed with one inch of cellulose insulation. Windows are triple-glazed, and construction joints are well-caulked. No exotic construction techniques or products were used in energy conservation measures.

The south side of the house has two passive solar design systems. The other is 125 square feet of thermopane windows covered by the overhang of the roof. Nine 12-inch diameter, rigid 7-foot tall plastic cylinders filled with water absorb excess sunshine coming through the windows.

The active system consists of a simple site-fabricated collector and storage system. The system has one control for turning the collector pump on and off, and one conventional house thermostat for circulating solar-heated air into the house. It has no other pumps or fans, no dampers, no control valves, no heat exchangers, no heat transfer fluids, no expansion valves. The 475 square foot collector also preheats domestic hot water besides heating the building's interior.

The total installed cost of the incremental energy conservation features, as well as the passive and active solar systems, was $8000 after subtracting a $1000 savings on the simplified heating system. The active system alone cost $16 per square foot of collector. The men who built the system estimated that they could build the second such system for $13 per square foot. (T.E.A., Inc. has recently completed, under contract with DOE, a detailed construction manual for building site-fabricated, air-heating solar systems. The estimated total installed cost for the entire system is $22 per square foot of collector).

The owner-occupants live in comfort in Goosebrook. Temperatures range from 70 to 75°. The only back-up is off-peak electricity (the house is all-electric). In the first two heating seasons, when the off-peak electric system was left untouched and therefore lost heat continuously, even during long periods of sunny weather, heating bills totalled $160 per year. So far this winter, electric heating has cost $81, despite higher prices per kwh. The projected total for the season is $100. There is no other source of heat. (The back-up could be an oversized gas or oil-fired water heater instead of electricity). The heating bill for the same house in Washington would be about $50 per year.

All of the heat for water is provided by the sun during the summer months. The average annual hot water bill is $60.

The $8000 conservation and solar investment costs the homeowners $67 per month. At today's prices, the annual energy savings would be $1000 if the house were heated by L.P. gas and $1700 if by oil. The actual savings is $1900 for the electrically-heated house. Thus, the cash flow of the homeowners is immediately positive, in spite of the incremental costs. This argument, in fact, convinced a bank to finance the house. It convinced the present owners to buy the house. And it will convince the next buyers of the house to value the incremental cost of the energy features over the amount of their initial cost. Thus, when energy prices double again, it is likely that the $8000 incremental cost will be worth roughly $16,000.

Conventional housing uses between 10 and 20 Btus per square foot per degree day for heating and cooling. This house uses less than .9 Btus per square foot per degree day, roughly 7000 Btus per square foot per year in New Hampshire.

In addition to its financial and energy rewards, the home also enhances the experience of being alive. It was called the "lightest and airiest" (solar) home experienced by the Atlantic Monthly. The house is always warm, while the rest of us shiver trying to save energy by turning back our thermostats. There are no nasty, chilly drafts. The house is tight, but not stuffy. It is quiet because there is little mechanical equipment. It is clean because the heating system is on only occasionally. It is safe because there is minimal use of gas, oil, or electricity, and because there is nothing dangerous about these active or passive solar designs. It is reliable because the solar systems are simple and because the back-up system is simple and used very little. Finally, the greenhouse enables homeowners, if they desire, to grow fresh vegetables and other plants year-round.

Lessons Learned

This home is not unusual. It is representative of hundreds, if not thousands, of homes throughout the country which use substantially less energy than houses built under the proposed BEPS. However, Goosebrook demonstrates and substantiates that energy consumption in buildings, and particularly in residential buildings, can be reduced substantially below what is often believed to be possible. It also demonstrates that this can be achieved using state-of-the-art technology, products and construction techniques. And it can be done at a cost which will provide the building owners positive cash flow immediately. The incremental cost is a good investment which will pay dividends upon resale of the house. The resulting buildings are far superior in value to those being built today. Long term financing is critical for providing positive cash flow. Adequate financing must be available when BEPS is implemented. Financiers must be ready to cooperate. Incremental construction costs provide the contractor with additional profit and with additional business activity.

These conclusions are not necessarily to suggest that the Standards should, at this time, be made more stringent. The financial community does not yet have the necessary confidence to finance minimum-energy buildings, despite their investment advantages. This takes time and extensive education. Architects and builders do not yet have the simplifying design tools to readily reach low-energy levels without greatly increasing the burden on their already strained design fees. Builders do not yet have adequate knowledge and information to build buildings which reach minimum levels, nor do they have confidence that, if built on speculation, they can be sold. Homeowners do not yet have access to enlightened financial institutions nor do they have confidence that they will be able to resell a somewhat more expensive home.

However, the Standards presently called for in BEPS are easily achieved, in comparison, and do not face nearly the obstacles for implementation that would be faced by the achievable, stringent standards exemplified by Goosebrook. BEPS can make a major contribution toward accomplishing our National energy and social goals: a) if they are properly implemented; b) if adequate financial mechanisms are available; c) if an adequate major education and training program is implemented; d) if the program is carefully phased into the building construction industry; and f) if a major continuing effort to update and revise the Standards is in place and operating smoothly.

I would like to offer my services, and those of the organizations I am affiliated with, to help in whatever way we can: to help detail necessary financial mechanisms; to help coordinate and implement a substantial education and training program; and to help bridge the many disparate interests of building industry professionals. Most of us are in agreement that lower energy consumption by buildings is an important step in resolving our national energy dilemma; enlightened cooperation, softening of self-interests, and mutual respect and understanding of the needs of all parties is important if we are to achieve our national goals and to provide a more benign and sustainable future for all mankind.

APPENDIX XII

Additional Material Submitted for the Record

American Hotel & Motel Association
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June 11, 1980

The Honorable J. Bennett Johnston
Chairman
Subcommittee on Energy Regulation
3202 Dirksen Senate Office Building
Washington, DC 20510

Dear Senator Johnston:

We are the American Hotel & Motel Association which is a federation of hotel and motel associations located in the fifty states, the District of Columbia, Puerto Rico and the Virgin Islands, having a membership of approximately 7,500 hotels and motels accounting for over one million rentable rooms. The American Hotel & Motel Association maintains offices at 888 Seventh Avenue, New York City and at 1101 Connecticut Avenue, N.W., Washington, DC.

We wish to use this opportunity to provide your Subcommittee with views our industry has presented to the Department of Energy on their proposed Building Energy Performance Standards (BEPS).

Our Association provided DOE with these comments on April 21 and 22 and we feel they should be incorporated in the hearing record your Subcommittee is developing respecting this issue. (Enclosed are the Association's views as presented by Messrs. Aulbach and MacGrath).

We deeply appreciate your holding hearings on this issue and believe that the Department's BEPS proposal should be delayed for at least a year at minimum to provide time for more comment and a rewriting.

Thank you for making our views part of the record.

Sincerely,

Albert L. McDermott

Albert L. McDermott
Washington Representative

ALM/vep

Enclosures

Jim Goffigan

RECEIVED
APR 25 1980

STATEMENT OF
AMERICAN HOTEL AND MOTEL ASSOCIATION
ON
DOE's PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS

PRESENTED BY EDWARD W. MACGRATH
ASSISTANT VICE PRESIDENT, MARRIOTT HOTEL ENGINEERING

SUBMITTED APRIL 21, 1980
J.W. McCORMACK
POST OFFICE & COURTHOUSE BUILDING
POST OFFICE SQUARE
BOSTON, MA 02102

My name is Ed MacGrath and I am Assistant Vice President of Hotel Engineering with Marriott Corporation.

I appear before you today in my capacity as Chairman of the American Hotel and Motel Association's Executive Engineer's Committee. The AH&MA welcomes this opportunity to comment on the Department of Energy proposed Building Performance Standards.

AH&MA is a federation of hotel and motel associations located in the 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands, having a membership in excess of 8500 hotels and motels and accounting for approximately 1,000,000 guest rooms. The AH&MA maintains offices at 888 7th Avenue, New York City, and at 1101 Connecticut Avenue, N.W., Washington, D.C. Inclusive in the Association's membership are all the major hotel and motel companies. As a result of contributions made by many of the industry companies, in May, 1972, the Association created the Hospitality, Lodging and Travel Research Foundation as a non-profit affiliate organization for inaugurating and implementing management research, programing, education, and on-the-premises operating techniques. In 1975 the Foundation took the added responsibility for developing an Energy Management Program which further sought to involve both employees and guests in a commitment to energy conservation through a personal involvement and concern. In 1976 the AH&MA established an Energy Technical Center, located in San Antonio, to centralize and coordinate the Association's energy data and information collection as well as to advise the membership on energy management techniques and technology. And also in 1976 the Association established an Executive Engineer's Committee composed of the Engineering Executives of about 20 of the major lodging companies. This group meets quarterly and reviews energy management strategies, technology, and regulations and communicates recommendations to the membership.

It is through the combined efforts of the Energy Technical Center and Executive Engineers that we have been able to accurately estimate the lodging industry's energy conservation efforts to date, and evaluate the possible good or bad effects of the proposed BEPS in terms of feasibility, cost and savings to the lodging industry.

Let me say first that hotels were in a position to react quickly to the 1973-4 fuel shortages because so much of the energy was subject to manual controls - by both employees and guests. Training and informing people, and minor adjustments to equipment and controls, produced immediate and substantial savings. We know these savings were over 10% in 1979, over 12% in 1978, and about 35% total since 1974. This is detailed on Exhibit I.

In addition to procedural efforts, we have used new technology - condenser heat recovery. chiller optimization, improved thermostatic controls, variable volume air systems, and other types of energy efficient equipment as well as computer systems to control and schedule equipment operations. Many recently constructed hotel/motels have been designed based on ASHRAE 90-75 or its equivalent. The lodging industry is dedicated to continued improvement to minimize energy use and cost through design changes and operational procedure changes.

Hotels are somewhat different than many classes of commercial buildings in that environment is a part of the service sold. For this reason, and the fact that energy consumption is highly influenced by building type and operational procedures, the performance type standard concerns us. The consumption of energy in a hotel - particularly one required to be designed to a performance standard - can vary widely as a result of operational procedures, nature of business activity, type of building and systems, and distribution of spaces, etc.

For example, systems in many larger hotels are designed for infrequent peak loads and normally operate at relatively low loads. This type of condition would be penalized under BEPS, but in fact could be more energy efficient than alternate approaches.

Although hotels normally range from 50 to 1000 + rooms, the "typical or average hotel is relatively small - less than 100 rooms - either with all-electric or mostly electrically energized unitary equipment This typical hotel would be penalized heavily under the BEPS electri weighting factors, and is very often located where alternate energy is impractical or not available.

Hotels are generally referred to as "thermally heavy" buildings - that is internal heat loads from people, kitchens, lighting, laundri and other process loads - reduce the need for building heat, but add considerably to cooling requirements causing hotels to be more dependent on electrical energy. A typical hotel could have 60 - 70% of electrical energy (BTU's) and 80 - 90% electrical (cost). Small hotels have no alternate for electrical cooling, while large hotels may be forced to use less efficient thermally energized absorption cooling.

Here again the weighting factor for electrical energy is penalizing and encourages designers to consider less efficient concepts.

We have studied the BEPS numbers and actually tested them on a sample of 61 existing hotels, comparing actual weighted energy consumption with the standard. These are buildings which have already reduced energy levels 35% through efforts described earlier. The proposed standards would call for an average of 172.7 thousand BTU's/Sq.Ft./Yr compared with 285.1 thousand now actually being used over by 65%. This is detailed in Exhibit II.

Robert Aulbach, AH&MA's Energy Consultant, has investigated the data in detail and actually used it in a computer model of a new hotel. His findings are being presented tomorrow 4/22 in Los Angeles and it is requested that his statement, along with this one, be considered as the AH&MA position of record.

Since the BEPS hearings started on March 24, our representatives have attended as observers, and reviewed many of the statements of groups whose positions are similar to ours. Rather than repeat many of the similar comments previously presented, I would like to summarize by calling to the attention of the DOE those elements of the proposed rule which we suggest are incorrect. These comments fall into four general categories -BEPS philosophy, accuracy of the data and standards, the procedure itself, and costs involved.

Philosophy

The philosophy of performance vs prescriptive standards has been discussed extensively. We feel strongly, because of the importance of operational procedures in hotels, that the prescriptive approach such as ASHRAE 90-75, which has been so effective in influencing energy efficient design, should be considered - at least to some extent.

We understand that BEPS is intended to generate savings beyond the present limits of ASHRAE 90-75, approximately 20% according to DOE estimates, but point out that the full effect of 90-75 is not yet known and that the introduction of BEPS as a performance standard may conflict rather than complement 90-75's prescriptive approach. Once again, the known effect of operational procedures influences our position on this.

Data

In respect to the data itself, the proposed standards for hotels provide a range of 150 to 200 thousand BTU's/Sq.Ft./Yr. - or 175 thousand mean ± 15%. We know from our own research that a group of similar hotels geographically distributed, will vary as much as 3 to 1. (See Exhibit II). This would seem to confirm that the BDPS data is restrictive to the extent that differences in hotel operations and spaces are not correctly provided for in the proposed allowances.

We understand that the hotel data was based on a sample of 5 or 6 actual buildings redesigned and modeled through the DOE II program, excluding restaurants, kitchens, laundries, and process loads, all of which are included in hotels. Because of the many differences in hotel structures, and mechanical/electrical systems, as well as size, type of business activity, etc., we feel that the sample itself is too small to subject to computer modeling and then apply effectively to thousands of new or proposed buildings.

Procedure

The procedure is complicated and will require extensive training. The various new concepts and terms in the proposed regulation - Design Energy Budget, Energy Budget Level, Standard Evaluation Technique - and using the limited and not yet fully validated DOE II program - is complicated and will be very difficult to accomplish. Owners, developers, designers, as well as state and local approval officials, must be familiar with this new and different procedure - understanding its complexities, exceptions, limitations, and purpose.

Costs

The question of added costs has been covered in a number of statements. Certainly development and design costs will increase - perhaps 20%. Construction and operating costs for hotels will also increase, particularly large hotels, because the proposed standards will encourage less efficient unitary and thermal cooling equipment ignoring the effect of operational efficiencies.

In conclusion, the AH&MA appreciates and respects the efforts of the DOE in researching and developing the proposed Building Performance Standards. We share many of the more general reactions concerning complexity, timing, weighting factors, data validity, costs, environmental elements, and enforcement.

We feel the proposed standards in their present form, are unacceptable to the lodging industry and should be delayed and revised for reasons detailed earlier. We do not recommend a performance standard without prescriptive alternates; the electrical weighting penalty will adversely effect all hotels and particularly the small typical hotel, and will tend to introduce less efficient and more costly equipment; and the procedure itself will be ineffectively complicated causing confusion, misunderstandings and distortion of design priorities.

We feel that continued professional application of ASHRAE 90-75 along with economic incentives of energy cost escalation, the lodging industry will continue to reduce energy use to a level consistent with the objective of BEPS - and faster.

We appreciate the opportunity to present the position of the AH&MA regarding the proposed Building Performance Standards, and hope that the final rule will include these considerations.

EWM/pbt

EXHIBIT I

HAS THE HOTEL-MOTEL INDUSTRY CONSERVED ENERGY SINCE 1972?

An indication of the hotel-motel industry's effort to conserve and manage its energy use during the period 1972-1978 is revealed through an analysis of the annual survey of hotel-motel operating costs published by Harris, Kerr, Forster & Company, Certified Public Accountants, 420 Lexington Avenue, New York, NY. 10017.

Harris, Kerr, Forster surveys 800 hotels-motels in the United States that are representative of the industry to determine average industry revenues and operating costs. An item included in this annual analysis is the cost of energy per available room.

The survey is considered to be representative of the U.S. hotel-motel industry. For example, the 800 properties surveyed 1976-1978 included the following types of properties located in different geographical and climatic areas. Energy costs per available room is also shown.

Type of Property	Energy Cost per Available Room Per Year		
	1976	1977	1978
300 transient	$606	$693	$742
100 Resort	668	750	866
300 with Restaurants	437	500	547
100 without Restaurants	393	449	467
800 hotels-motels (Average Cost)	$564	$644	$697

Table 1, attached, shows that energy cost per available room of the hotels-motels surveyed (in excess of 200,000 rooms) increased from $415 in 1972 to $697 in 1978 - the last year for which compiled and analyzed data is available. An increase in cost of energy per available room of 68 percent from 1972 through 1978 is indicated.

Energy use data on file at the AH&MA Energy Technical Center shows that annual energy use of hotels-motels nation-wide is composed of approximately 45 percent electricity and 55% fossil fuels, primarily natural gas. Table 2 calculates an estimated 174 percent average increase in unit costs of energy used by the industry during the period 1972-1978.

Tables 1 and 2, when compared, indicate that while the energy cost per available room increased only 68 percent during the period 1972-1978, the cost of energy increased 174 percent.

....THEREFORE, it can be assumed that if the hotel-motel industry's energy use per available room had remained constant since 1972, the average annual cost of energy per available room would have been in the order of $1,137 instead of the $697 as reported by Harris, Kerr, Forster & Company and shown in Table 1.

Table 1

Harris, Kerr, Forster & Co.
Certified Public Accountants
Annual Survey of Hotels/Motels
(U.S.A. Edition, Trends in the Hotel-Motel Industry, 1973 thru 1979 issue)

	1972	1973	1974	1975	1976	1977	1978
Available Rooms	232,489	247,144	253,074	268,458	221,157	212,571	212,679
Energy Cost (Millions $)	96.4	108.7	140.8	168.0	124.7	136.9	148.1
Cost/Available Rooms ($)	415	430	556	626	564	644	697
Percent Annual Increase	-	3.6	29.3	12.6	-9.0	14.2	8.2

Note: Survey for 1972 thru 1975 included 1,000 Hotels & Motels.
For the years 1976, 1978, 1979 survey included 800 Hotels & Motels composed of 300 transient, 100 resort, 300 with restaurants and 100 without restaurants.

Source: Harris, Kerr, Forster & Company, 420 Lexington Ave., New York, NY 10017 (Trends in the Hotel-Motel Business, U.S.A. Edition for years 1973 through 1979)

Table 2

Hotel-Motel Industry
Estimated Increase in Cost of 1 Million Btu's of Energy[1]
1972-1978

	1972		1978	
Cost of Electricity (per Kwh)	1.2¢		3.2¢	
Cost of 450,000 Btu's (131.9 Kwh)		$ 1.58		$4.22
Cost of Natural Gas (per therm)	6.5¢		20.0¢	
Cost of 550,000 Btu's (5.5 therms)		0.36		$1.10
Cost per Million Btu's (45% electricity & 55% natural gas)		$ 1.94		$5.32
Increase in Cost of 1 Million Btu's 1972 versus 1978				$3.38
Percent Increase 1972-1978				174%

Note:

[1] Composition of the 1 million Btu's is based on average mix of energy sources of industry - 45% electricity; 55% fossil fuel (natural gas). Costs are based on national average for type of rate schedule and volume of use by the average size property.

Estimated Annual Energy Savings
American Hotel & Motel Association (U.S. Membership only)
Adjusted for Annual Change in Square Feet of Area
1977, 1978, 1979

Year	Sq Ft (Millions)	Btu/Sq Ft[1]	Total Btu's (Trillions)	Reduction (Trillion Btu's)	BOE[2]	Annual Savings BOE[2]
1977 (Base Year)	488.8	181,685	88.8	(Base)	15,102,040	(Base)
1978 (Based on 1977)	554.1	181,685	100.7		17,125,850	
1978 (Actual)	554.1	158,736	88.0		14,965,986	
Reduction				12.7		
Savings/1978 vs 1977						2,159,864
1979 (Based on 1978)	570.6	158,736	90.6		15,408,163	
1979 (Actual)	570.6	142,699	81.4		13,843,537	
Reduction				9.2		
Savings/1979 vs 1978						1,564,626
Savings/1979 vs 1977				21.9		3,724,490

Notes:

[1] Btu/sq ft Based on Energy Use Survey in 1977 of 210 properties (42.6 million sq ft); in 1978 on 327 properties (52.6 million sq ft); in 1979 on 288 properties (40.0 million sq ft)

[2] Barrel of Oil equivalent (BOE) is based on No. 2 fuel oil at 140,000 Btu/gallon or 5,880,000 Btu/barrel.

EXHIBIT II

ANNUAL ENERGY REQUIREMENTS OF EXISTING HOTELS/MOTELS (1978)
AND APPLICATION OF WEIGHTING FACTORS AS PROPOSED IN DOE's
BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)
(All Calculations in Btu/sq ft/yr)

Property Location (State)	Size of Property (Sq Ft)	Energy Requirements[1] (Btu/Sq Ft/Yr) Electricity	Fossil Fuel	Total	Less Exempt Areas[2] 5% of Electricity	20% of Fossil Fuel	Adjusted Requirement (Btu/Sq Ft/Yr) Electricity	Fossil Fuel	Total	Adj. Req. X DOE Weighting Factors[3] (Btu/Sq Ft/Yr) Electricity	Fossil Fuel	Total	BEPS (Btu/Sq Ft/Yr) Allowable	Excess
Alabama	96,321	82,263	45,722	127,985	4,113	9,144	78,150	36,578	114,728	240,702	36,578	277,280	166,000	111,280
Alabama	103,680	79,568	59,801	139,369	3,978	11,960	75,590	47,841	123,431	232,817	47,841	280,658	166,000	114,658
Arizona	88,664	63,531	78,825	142,356	3,177	15,765	60,354	63,060	123,414	185,890	63,060	248,950	196,000	52,950
Arizona	71,426	76,804	70,098	146,902	3,840	14,020	72,964	56,078	129,042	224,729	56,078	280,807	196,000	84,807
California	77,140	53,159	82,160	135,319	2,658	16,432	50,501	65,728	116,229	155,543	65,728	221,271	150,000	71,271
California	102,584	72,334	157,022	229,356	3,618	31,404	57,867	125,618	183,485	222,788	125,618	348,406	158,000	191,406
California	90,106	65,579	56,867	122,446	3,279	11,373	62,300	45,494	107,794	201,983	45,494	247,477	157,000	90,477
California	64,484	72,744	43,506	116,250	3,637	8,701	69,106	34,805	103,911	212,848	34,805	247,654	157,000	90,654
California	1,186,000	57,629	79,984	137,613	2,881	15,997	54,748	63,987	118,735	168,622	63,987	232,609	150,000	82,609
Colorado	91,542	56,605	92,518	149,123	2,830	18,503	53,775	74,014	127,789	165,626	74,014	239,640	162,000	77,640
Florida	148,582	95,537	37,670	133,207	4,777	7,534	90,760	30,136	120,896	279,541	30,136	309,677	203,000	106,677
Florida	48,250	116,531	10,695	127,226	5,827	2,139	110,704	8,556	119,260	340,970	8,556	349,526	196,000	153,526
Florida	131,870	77,084	57,609	134,693	3,854	11,522	73,230	46,087	119,317	225,548	46,087	271,635	198,000	73,635
Florida	76,200	111,537	10,748	122,285	5,577	2,150	105,960	8,598	114,558	326,357	8,598	334,955	193,000	141,955
Georgia	109,320	80,455	54,021	134,476	4,023	10,804	76,432	43,216	119,648	235,411	43,216	278,628	165,000	113,628
Georgia	1,170,600	84,311	31,704	116,015	4,215	6,341	80,095	25,363	105,458	246,693	25,363	272,056	165,000	107,056
Georgia	219,130	72,949	120,047	192,996	3,647	24,009	69,302	96,038	165,340	213,449	96,038	309,487	165,000	144,487
Illinois	330,900	40,937	81,892	122,919	2,047	16,378	38,890	65,514	104,404	119,782	65,514	185,296	167,000	18,296
Illinois	284,336	65,442	50,384	115,826	3,272	10,077	62,170	40,307	102,477	191,483	40,307	231,790	167,000	64,790
Illinois	296,080	131,328	14,754	146,082	6,566	2,951	124,762	11,803	136,565	384,266	11,803	396,069	167,000	229,069
Indiana	391,600	45,395	201,635	247,030	2,259	40,327	43,125	161,308	204,433	132,826	161,308	294,134	168,000	126,134
Indiana	91,408	47,290	111,030	158,320	2,365	22,206	44,926	88,824	133,750	145,653	88,824	234,477	168,000	66,477
Louisiana	76,768	97,256	53,564	150,820	4,863	10,713	92,393	42,851	135,244	284,571	42,851	327,422	192,000	135,422
Louisiana	68,575	104,964	77,098	182,062	5,248	15,420	99,716	61,678	161,394	307,125	61,678	368,703	194,000	174,703
Massachusetts	103,689	39,102	117,894	122,285	1,955	23,579	37,147	94,315	131,462	114,412	94,315	208,727	165,000	43,727
Massachusetts	970,000	51,275	174,211	225,486	2,564	34,842	48,711	139,369	188,080	150,031	139,369	289,400	165,000	124,400
Michigan	83,478	56,571	104,806	161,377	2,829	20,961	53,742	83,845	137,587	165,526	83,845	249,371	168,000	81,371
Michigan	65,228	58,686	135,256	193,942	2,934	27,051	55,752	108,205	163,957	171,715	108,205	279,920	168,000	111,920

Notes: 1 These calculations are based on 3,412 Btu/Kwh for electricity; 100,000 Btu/therm for natural gas; 140,000 Btu/gal for fuel oil and 1,000 Btu/lb of purchased steam.

2 Exempt areas include kitchens and laundries. All properties included in this analysis have a laundry and at least one kitchen. For the pu pose of this analysis it is estimated that the laundry and kitchen account for 5% of electric use and 20% of fossil fuel use.

3 BEPS proposed weighting factors are applied to the adjusted energy requirement - 3.08 for electricity and 1.0 for natural gas. In this analysis all fossil fuels are assumed to be natural gas.

ANNUAL ENERGY REQUIREMENTS OF EXISTING HOTELS/MOTELS (1978)
AND APPLICATION OF WEIGHTING FACTORS AS PROPOSED IN DOE's
BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)
(All Calculations in Btu/sq ft/yr)

Property Location (State)	Size of Property (Sq Ft)	Energy Requirements[1] (Btu/Sq Ft/Yr)			Less Exempt Areas[2]		Adjusted Requirement (Btu/Sq Ft/Yr)			Adj. Req. X DOE Weighting Factors[3] (Btu/Sq Ft/Yr)			BEPS (Btu/Sq Ft/Yr)	
		Electricity	Fossil Fuel	Total	5% of Electricity	20% of Fossil Fuel	Electricity	Fossil Fuel	Total	Electricity	Fossil Fuel	Total	Allowable	Excess
Minnesota	69,189	48,[illegible]	128,759	177,755	2,450	25,752	46,546	103,007	149,553	143,362	103,007	246,369	180,000	66,369
Minnesota	103,000	83,355	101,502	184,857	4,168	20,300	79,187	81,202	160,389	243,896	81,202	325,098	180,000	145,098
Minnesota	82,386	32,994	147,383	180,377	1,650	29,477	31,344	117,906	149,250	96,540	117,906	214,446	180,000	34,446
Minnesota	61,020	52,784	178,864	231,648	2,639	35,773	50,145	143,091	193,236	154,447	143,091	297,538	180,000	117,538
Mississippi	91,746	113,131	67,377	180,508	5,657	13,475	107,474	53,902	161,376	331,020	53,902	384,922	171,000	213,922
Mississippi	72,776	70,662	82,994	153,656	3,533	16,599	67,129	66,395	133,524	206,757	66,395	273,152	171,000	102,152
Mississippi	116,119	78,870	82,290	161,160	3,944	16,458	74,926	65,832	140,758	230,772	65,832	296,604	171,000	125,604
Missouri	135,999	71,174	85,870	157,044	3,559	17,174	67,615	68,696	136,311	208,254	68,696	276,950	174,000	102,950
Missouri	125,795	55,138	93,477	148,615	2,757	18,695	52,381	74,782	127,163	161,333	74,782	236,145	174,000	62,115
Nebraska	323,152	36,201	82,426	118,627	1,810	16,485	34,391	65,941	100,332	105,924	65,941	171,865	170,000	1,865
Nevada	89,814	80,421	38,585	119,006	4,0[illegible]	7,717	76,400	30,868	107,268	235,312	30,868	266,180	174,000	92,180
Nevada	152,763	68,001	87,833	155,834	3,400	17,567	64,601	70,266	134,867	198,971	70,266	269,237	174,000	95,237
New York	113,170	105,908	14,727	120,635	5,295	2,945	100,613	11,782	112,395	309,888	11,782	321,670	170,000	151,670
New York	160,826	124,674	-0-	124,674	6,234	0-	118,440	-0-	118,440	364,795	-0-	364,795	172,000	192,795
New York	124,161	55,240	66,446	121,686	2,762	13,2[illegible]	52,478	53,157	105,635	161,632	53,157	214,789	168,000	46,789
New York	1,626,560	47,939	96,781	144,720	2,397	19,356	45,542	77,425	122,967	140,269	77,425	217,694	168,000	49,694
North Carolina	112,600	141,404	-0-	141,404	7,070	-0-	134,334	-0-	134,334	413,749	-0-	413,749	167,000	246,749
North Carolina	87,644	63,907	129,451	193,358	6,473	25,890	[illegible]7,434	103,561	160,995	176,897	103,561	280,458	167,000	113,458
Ohio	97,171	79,056	61,869	140,925	3,043	12,374	76,103	49,495	124,508	231,318	49,495	280,813	168,000	112,813
Ohio	77,922	81,410	86,539	167,949	4,070	17,308	77,3[illegible]	69,213	146520	238,206	69,213	307,419	172,000	135,419
Ohio	61,575	69,571	70,965	140,536	3,548	14,193	66,023	56,772	122,795	203,351	56,772	260,123	172,000	88,123
Ohio	54,528	43,264	177,797	221,061	2,163	35,559	41,101	[illegible]	183,339	126,591	142,238	268,829	172,000	96,829
Oklahoma	127,258	110,173	3,692	110,173	5,509	738	104,664	2,[illegible]64	107,628	322,365	2,964	325,329	170,000	155,329
Oklahoma	86,314	105,499	91,004	196,503	5,275	18,201	100,224	72,8[illegible]	173,027	300,690	72,803	381,493	170,000	211,493
Oregon	304,965	59,505	104,238	163,743	2,976	20,848	56,530	83,390	139,920	174,112	83,390	257,502	161,000	96,502
Pennsylvania	322,295	65,510	75,350	140,860	3,276	15,070	62,234	60,280	122,514	191,681	60,280	251,961	173,000	78,961
Pennsylvania	72,713	86,626	75,172	155,798	4,331	15,034	82,295	60,138	142,433	253,469	60,138	313,607	173,000	140,607
Pennsylvania	155,351	42,821	151,495	194,316	2,141	30,299	40,680	121,196	161,876	125,294	121,196	246,490	171,000	75,490

Notes: 1 These calculations are based on 3,412 Btu/Kwh for electricity; 100,000 Btu/therm for natural gas; 140,000 Btu/gal for fuel oil and 1,000 Btu/lb of purchased steam.

2 Exempt areas include kitchens and laundries. All properties included in this analysis have a laundry and at least one kitchen. For the purpose of this analysis it is estimated that the laundry and kitchen account for 5% of electric use and 20% of fossil fuel use.

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Property Location (State)	Size of Property (Sq Ft)	Energy Requirements[1] (Btu/Sq Ft/Yr)			Less Exempt Areas[2]		Adjusted Requirement (Btu/Sq Ft/Yr)			Adj. Req. X DOE Weighting Factors[3] (Btu/Sq Ft/Yr)			BEPS (Btu/Sq Ft/Yr)	
		Electricity	Fossil Fuel	Total	5% of Electricity	20% of Fossil Fuel	Electricity	Fossil Fuel	Total	Electricity	Fossil Fuel	Total	Allowable	Excess
South Carolina	103,982	87,177	56,260	143,437	4,359	11,252	82,818	45,008	127,826	255,079	45,008	300,087	168,000	132,087
South Carolina	61,200	145,703	56,953	202,656	7,285	11,391	138,418	45,562	183,980	426,327	45,562	471,889	168,000	303,889
Tennessee	80,612	80,046	47,855	127,901	4,002	9,571	76,044	38,284	114,328	234,216	38,284	272,500	168,000	104,500
Tennessee	61,020	62,849	147,889	210,738	3,142	29,578	59,707	118,311	178,018	183,898	118,311	302,209	168,000	134,209
Texas	171,205	61,484	93,083	154,567	3,074	18,617	58,410	74,466	132,876	179,903	74,466	254,369	175,000	79,369
Texas	91,520	85,709	81,199	166,908	4,285	16,240	81,424	64,959	146,383	250,786	64,959	315,745	196,000	119,745
Texas	52,406	54,550	171,950	226,500	2,728	34,390	51,822	137,560	189,382	159,612	137,560	297,172	195,000	102,172
Texas	511,580	60,904	295,182	356,086	3,045	59,036	57,859	236,146	294,005	178,206	236,146	414,352	195,000	219,352
Virginia	60,167	110,276	16,204	126,480	5,514	3,241	104,762	12,963	117,725	322,667	12,963	335,630	165,000	170,630
Virginia	257,560	29,339	155,904	185,243	1,467	31,181	27,872	124,723	152,595	85,846	124,723	210,569	171,000	39,569
Wisconsin	57,770	63,600	95,126	158,726	3,180	19,025	60,420	76,101	136,521	186,094	76,101	262,195	170,000	92,195
Wisconsin	155,884	42,172	61,080	103,252	2,109	12,216	40,063	48,864	88,927	123,394	48,864	172,258	170,000	2,258

Average 172,690

Average 112,471

Prepared by the

Energy Technical Center
Hospitality, Lodging & Travel
Research Foundation, Inc.
Ste 1694, 84 N.E. Loop 410
San Antonio, TX 78216

February 6, 1980

Notes: 1 These calculations are based on 3,412 Btu/kwh for electricity; 100,000 Btu/therm for natural gas; 140,000 Btu/gal for fuel oil and 1,000 Btu/lb of purchased steam.

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APR 24 1980

AMERICAN HOTEL & MOTEL ASSOCIATION STATEMENT
PROPOSED BUILDING PERFORMANCE STANDARDS AT
PUBLIC HEARING IN LOS ANGELES
APRIL 22, 1980

My name is Robert Aulbach, President of Robach, Inc., Energy Management Consultants.

I appear before you today in my capacity as energy consultant to the American Hotel & Motel Association. The AH & MA welcomes this opportunity to comment on the Department of Energy proposed Building Performance Standards.

AH & MA is a federation of hotel and motel associations located in the 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands, having a membership in excess of 8,500 hotels and motels accounting for approximately 1,000,000 guest rooms.

The testimony I am about to give is to be considered in conjunction with that presented by Mr. Ed MacGrath for AH & MA, at the Department of Energy hearings in Boston on April 21.

Robach, Inc. having been consultant to AH & MA for the past five years, and having served the major hotel companies as well as numerous independent operators as energy consultant feels eminently qualified to comment on the proposed Building Performance Standards as it relates to hotel design and operations.

First of all we believe that the hotel industry has made great strides on its own initiative to reduce the energy consumption of its properties. The Association's Energy Technical Center in San Antonio, Texas was established four years ago at considerable investment to the industry to collect energy consumption date, conservation techiques, publish manuals and generally provide a data base from which the industry can draw from.

Using data that has been collected since 1977 it is estimated that the industry now consumes approximately 13,843,000 equivalent barrels of oil per year. Further our data indicates that the industry has saved since 1977 3,725,000 barrels of oil equivalent indicating a reduction of approximately 22%. Exhibit 1 attached shows a breakdown of this information.

Further new hotel designs that we have studied show projected energy consumption by computer modeling of 15% to 20% from that that was considered normal a few years back, in as much as 50% less than properties designed prior to 1972.

In order to intelligently evaluate the proposed BEPS, we attempted to simulate a recently designed hotel property having approximately 376 guest rooms, meeting rooms, ballroom, lobby, indoor swimming pool as well as restaurant and kitchen facilities. We used this property because it had been computer modeled for the purpose of providing an efficient energy consuming property. The design considerations of this hotel include most of the economical energy conservation considerations that are considered the state of the art today. This hotel was remodeled using the BEPS criteria to determine if this property would be in compliance.

A summary of the results of this modeling is attached and identified as Exhibit 2, and indicates that the design would be in substantial compliance with the BEPS budget if it were not for the weighting factors for electric energy which must be applied.

In as much as 70% of the energy used by this property is what we call base electric (lights, fans, motors, etc.) the majority of the energy reduction must be accomplished in these systems. The air conditioning and its accessories consume only approximately 15% of the energy, thus requiring little opportunity for changes that would bring the property into compliance except possibly eliminating electric air conditioning and substituting gas or oil fired equipment.

The exercise that we have accomplished indicates to us that the weighting factors are inappropriate, and would place a substantial burden upon the hotel industry, particularly smaller 50 to 100 room properties which very often are all electric. We believe that the weighting factors would eliminate virtually all new construction of these smaller properties that provide the majority of the guest rooms for the low-income traveler, and further would substantially increase the cost of all hotel construction by as much as 30%.

The proposed Performance Standards are based on computer simulations of only five hotels. Our studies and experience indicate that it is extremely difficult if not impossible to represent this industry with such a small sample, and that any standards based on such a small sample would be unfair.

The evaluation technique as indicated in the documents that we have been able to review are incomplete with many omissions, incorrect assumptions as well as several contradictions. In order for us to perform the above-mentioned computer simulation it was necessary for us to make several of our own determinations.

We had asked the Department of Energy for a technical seminar at which we could bring up our problems for their clarification. This request was refused, therefore it was necessary for us to proceed with incomplete information.

The BEPS does not consider the various types of hotels e.g. commercial, resort, convention, etc. Nor does it consider that the ratio of guest rooms' floor area to public space floor area may vary considerably between types and sizes of properties. This has a dramatic effect on the relative energy consumption of the different types of operations.

Design, modeling and remodeling of the initial design will add from $40,000 to $100,000 to the initial design cost. This will be a very large burden to small property designs.

The modeling criteria established by the BEPS does not match the actual known hotel operating characteristics, thus providing a distorted energy consumption evaluation, that cannot be matched in actual operation. By reviewing Exhibit 2 you will note that the air conditioning load is considerably lower in the design versus BEPS and that domestic hot water consumption is about 30% higher in the design model versus the BEPS.

AH & MA believes that the weighting factors for fuel sources do not consider the source of fuel for power generation, such as hydro, nuclear, coal etc., and that if the weighting factors are to be used consideration should be given as to the primary fuel sources for generation. AH & MA further believes that the BEPS are attempting to establish national energy policy which should be dealt with in another formum considering the broad implications on many industries and their future.

The method of determining the energy budget (BTU/ft^2) for various cities is not clear. Why should cities in the state of Louisiana be allowed 194,000 BTU/ft^2 and Chicago only being allowed 167,000 BTU/ft^2?

AH & MA believes that the BEPS design will force us into inefficient operations e.g. equipment oversized to meet BEPS operating criteria will consume more energy in operation. Further it will be necessary to divert capital from more efficient systems to complying with the BEPS.

Much of the basis for the regulation is incomplete at this time, such as the DOE II Computer Program For Evaluation, it appears unfair that hearings be held on a regulation that is incomplete preventing us from making a more accurate detailed analysis.

The evaluation techiques and imputs are scattered throughout several documents with many questions unanswered, conflicting information and wide gaps.

AH & MA believes that the ASHRA Standard 90-75R can better accomplish the goals of reducing energy consumption than can the BEPS as presently conceived.

SUMMARY

AH & MA believes that the BEPS as presently conceived would adversely effect the hotel and motel business, virtually eliminating new properties for the small operator, that would add overwhelming additional costs without substantially effecting the energy consumptio of the operating property.

AH & MA further believes that the weighting factors should be eliminated from the BEPS regulations as it creates a distortion in the real energy consumption of the property and places an unnecessary burden on the hotel and motel which out of economic necessity and availability must use electric energy for substantial portions of its loads.

The BEPS provides no credit for operational energy conservatio opportunities which can result from better control devices etc.

It is AH & MA's intent to provide a more detailed paper describing computer modeling that was accomplished, and the specific problems that were encountered attempting to use the BEPS criteria in the modeling process.

In conclusion, the AH & MA appreciates and accepts the efforts of the Department of Energy in researching and developing the Proposed Building Performance Standards. We share many of the more general reactions of other associations concerning complexity, timing, weighting factors, data validity, costs, environmental elements and enforcement.

We feel the proposed standards in the present form, are unacceptable to the lodging industry and should be delayed for more complete study and revision, utilizing the information and resources that can be provided by the hotel industry, but for reasons best known to the Department of Energy were not utilized.

Estimated Annual Energy Savings
American Hotel & Motel Association (U.S. Membership only)
Adjusted for Annual Change in Square Feet of Area
1977, 1978, 1979

Year	Sq Ft (Millions)	Btu/Sq Ft[1]	Total Btu's (Trillions)	Reduction (Trillion Btu's)	BOE[2]	Annual Saviggs BOE[2]
1977 (Base Year)	488.8	181,685	88.8	(Base)	15,102,040	(Base)
1978 (Based on 1977)	554.1	181,685	100.7		17,125,850	
1978 (Actual)	554.1	158,736	88.0		14,965,986	
Reduction				12.7		
Savings/1978 vs 1977						2,159,864
1979 (Based on 1978)	570.6	158,736	90.6		15,408,163	
1979 (Actual)	570.6	142,699	81.4		13,843,537	
Reduction				9.2		
Savings/1979 vs 1978						1,564,626
Savings/1979 vs 1977				21.9		3,724,490

Notes:

1 Btu/sq ft Based on Energy Use Survey in 1977 of 210 properties (42.6 million sq ft); in 1978 on 327 properties (52.6 million sq ft); in 1979 on 288 properties (40.0 million sq ft)

2 Barrel of Oil equivalent (BOE) is based on No. 2 fuel oil at 140,000 Btu/gallon or 5,880,000 Btu/barrel.

EXHIBIT #1

SUMMARY OF ENERGY USE
BEPS HOTEL EVALUATION COMPUTER MODEL

ENERGY USE	DESIGN MODEL		BEPS UNWEIGHTED		BEPS WEIGHTED	
	MMBTU	%	MMBTU	%	MMBTU	%
Air Cond						
Chiller	1,004	2.44	2,756	9.65	8,488	11.86
Acc	305	0.74	713	2.49	2,196	3.07
Heating						
Gas	4,924	12.0	4,973	17.42	4,973	6.95
Acc	379	0.92	281	0.98		
Overall						
Acc	299	0.72	299	1.04	956	1.33
Base Elect	16,235	39.58	14,669	51.41	50,065	70.0
Lights	4,867	11.86	(4,867)	(17.04)		
Fans	5,730	13.96	(5,730)	(20.08)		
Heating	720	1.75	(720)	(2.52)		
Misc.	4,918	11.98	(4,918)	(17.23)		
Domestic Hot Water (Gas)	6,487	15.81	4,841	16.96	4,841	6.76
Total Energy	41,018	100.00	28,532	100.00	71,519	100.00
BTU/ft^2/yr	102,459		112,000		249,000	
Allowed	116,000		116,000		116,000	

EXHIBIT #2

STATEMENT OF THE
AMERICAN HOTEL & MOTEL ASSOCIATION
ON
PROPOSED ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS
BEFORE THE
DEPARTMENT OF ENERGY

May 1, 1980

We are the American Hotel & Motel Association which is a federation of hotel and motel associations located in the fifty states, the District of Columbia, Puerto Rico and the Virgin Islands, having a membership of approximately 7,500 hotels and motels accounting for over one million rentable rooms. The American Hotel & Motel Association maintains offices at 888 Seventh Avenue, New York City and at 1101 Connecticut Avenue, N.W., Washington, DC.

We wish to use this opportunity to supplement the statement already presented by Robert Aulbach at the BEPS hearing in Los Angeles on April 22.

AH&MA's energy consultants, Robach, Incorporated, has prepared these comments incorporating problems that have occurred in attempting to model a BEPS motel, reviewing of the DOE documentation as well as numerous discussions held with the engineering leaders of the industry.

In order to evaluate the proposed performance standards, we prepared a BEPS Computer Model of a recently designed 367 room hotel using STANDARD BUILDING OPERATING CONDITIONS and THE STANDARD EVALUATION TECHNIQUE.

This particular hotel was selected because it incorporated what we believe is the state of the art and design for energy conservation, and because this hotel was modeled initially to evaluate the energy consumption and the efficiency of the design.

The following are problems that were incurred in attempting to follow the BEPS criteria that would be required to prove compliance.

1. In general, we found that the profile and the people destinies did not follow those profiles that we believe more consistently represent hotel and motel operations.

We are attaching as Exhibit 1 profiles that we recommend be used in any future BEPS regulations. The energy consumption of equipment such as television sets, refrigeration, ice makers, etc., is set at zero which produces no internal gain to supplement the heating loads which is particularly significant in the northern climates.

The number of people per thousand square feet should be increased in the assembly areas to one hundred people per thousand square feet.

2. The BEPS documentation indicates that blinds or drapes are assumed to be drawn fifty percent of the time.

Our studies have shown that during the daylight hours seventy percent of the drapes and/or sheers are closed and in the night hours approximately ninety-five percent are closed.

3. Control temperatures for air handling units are not specified in the BEPS, as well as fan heat gains. Further, humidification and control points are not discussed in the performance standards. This can significantly affect the heating and humidification loads.

The part load performance for plant equipment is not indicated. This can significantly affect the loads depending on the efficiency of the equipment. By selecting equipment that has part hard load efficiency, the energy consumption can be substantially reduced.

No accessory loads were specified for pumps, cooling towers, etc.

The minimum and maximum supply air flow are not specified.

Exhaust air and minimum outside air are not specified.

4. The following are items that are not clear in the standard operating conditions:

U.S. holidays have not been specifically specified. Holidays are meaningless to hotel and motel operations.

Operational Profiles 168 and 181 are shown as zero. Schedule 168 covers mechanical, electrical, elevator shaft and stairwell equipment, as well as storage and enclosed parking. Schedule 181 covers the guest rooms.

Are deadband thermostats to be assumed?

What are we to do with systems and equipment that are not shown in section VII of the SET manual?

SUMMARY OF BEPS COMPUTER MODEL

Attached is Exhibit 2 which summarizes the results of the modeling study. As was pointed out at the hearings, the model hotel substantially complies with the BEPS energy budget if it were not for the weighting factors for the energy use.

Comparing the BEPS unweighted with the BEPS weighted energy consumption you will note that the consumption goes from 112,000 BTU's per square foot to 249,000 BTU's per square foot. With electric energy for lights, fans, limited electric heating and miscellaneous equipment accounting for fifty-one percent of the energy unweighted and seventy percent of the energy weighted, it is obvious that the major reduction opportunities must be accomplished in these systems. The fans as modeled account for approximately forty percent of the base electric energy in the BEPS model with few opportunities for reduction using the required profile.

Inasmuch as we are not allowed to reduce energy using operational opportunities, and that the BEPS requires virtual continuous operation, it appears that it would be impossible to reduce the energy consumption of this hotel using the BEPS modeling criteria.

A further reduction opportunity would be to convert the electric air conditioning to either natural gas or oil fired absorption. This would create an incentive to substitute other resources, such as, hydro, coal or nuclear.

A further concern of AH&MA is that smaller motels very often are all electric for both economic and resource reasons. It is our belief that these smaller properties would find it impossible to comply with the BEPS budget thereby making it unlikely to construct. This would reduce accommodations for the low income traveler.

To support our claim of up to thirty percent additional cost for a BEPS hotel, I would like to state the following:

> Reviewing with various hotel consulting engineers, it is their consensus that the substituting of absorption cooling for electric cooling will increase the cost of that system alone from thirty to thirty-five percent. The equipment alone on a recent bid was $225.00 per ton for two stage absorption (which is more efficient) versus $125.00 per ton for electric centrifugal.

We would be very happy to sit with your people and review the details of our study and any other information that would be beneficial to your department.

Exhibit 1

STANDARD PROFILE PERCENTAGE INFORMATION

(To Be Used Unless Further Data From
Property is Available)

GUEST ROOMS & CORRIDORS

People: (Room & Corr.)	90,1 20,1	100,4 10,2	90,1 30,2	70,1 10,3	60,1 50,4	40,1 70,3
Lights: (Room Only)	15,6 20,1	25,1 15,4	30,2 25,3	15,3 50,4		
People: (Corr. Only)	10,1 10,3	2,6 50,1	70,3 80,1	10,2 50,2	30,2 10,3	
Television:	5,2	0,5	50,2	25,8	50,2	35,5
Refrigerators:	25,24					
DHW	5,6 40,1	30,1 10,4	100,1 40,1	90,1 70,1	70,1 50,3	20,1 40,3

(This profile yields 8 times the hourly peak,
Example 8 gal/hr peak gives 84 gal/day

Fan Coil Fans:	100,10	60,6	100,8

MAIN LOBBIES

People	*Hvy	8,1 35,3	1,6 65,1	15,1 75,1	80,1 60,1	35,3 50,3	90,2 20,1
	*Med	8,1 35,3	1,6 60,1	15,1 65,1	65,1 45,1	25,3 30,3	75,2 15,1
	*Lit	8,1 20,3	1,6 50,1	15,1 55,1	55,1 30,1	25,3 20,1	35,2 10,1

Exhibit 2

SUMMARY OF ENERGY USE
BEPS HOTEL EVALUATION COMPUTER MODEL

ENERGY USE	DESIGN MODEL		BEPS UNWEIGHTED		BEPS WEIGHTED	
	MMBTU	%	MMBTU	%	MMBTU	%
Air Cond						
Chiller	1,004	2.44	2,756	9.65	8,488	11.88
Acc	305	0.74	713	2.49	2,196	3.07
Heating						
Gas	4,924	12.0	4,973	17.42	4,973	6.95
Acc	379	0.92	281	0.98		
Overall						
Acc	299	0.72	299	1.04	956	1.33
Base Elect	16,235	39.58	14,669	51.41	50,065	70.0
Domestic Hot Water (Gas)	6,487	15.81	4,841	16.96	4,841	6.76
	1/ 11,385					
Total Energy	41,018	100.00	28,532	100.00	71,519	100.00
BTU/ft^2/yr	102,459		112,000		249,000	
Allowed	116,000		116,000		116,000	

1/ Unaccounted for in BEPS e.g., laundry and kitchen.

Statement Of The
AMERICAN PUBLIC POWER ASSOCIATION

Presented To The
SUBCOMMITTEE ON ENERGY REGULATION
COMMITTEE ON ENERGY AND NATURAL RESOURCES

On The
DEPARTMENT OF ENERGY'S
BUILDING ENERGY PERFORMANCE STANDARDS

The American Public Power Association is the national service organization representing local publicly owned electric systems throughout the United States, American Samoa, Guam, Puerto Rico and the Virgin Islands. APPA and many of its members have participated in the proceedings of the Department of Energy relating to the formulation of building energy performance standards. Our main concerns are set forth below.

As nonprofit, locally governed suppliers of electricity, public power systems strongly support the development of national energy conservation standards for new construction. We concur with the Congress's finding in 1976 that large amounts of fuels and energy are consumed unnecessarily in all types of construction because buildings lack adequate energy conservation features. From the research performed under the BEPS program to date, it has been shown that buildings can be designed to meet the needs of their occupants, can be attractive, functional and cost-effective -- and can reduce energy consumption by 50 percent or more.

As suppliers of electricity to local communities, public power systems are aware of the uncertainties and cost of investing in new electric power generation. We think that conservation is an effective means of reducing the need for new generating capacity.

Conservation in new construction has the advantage of being cost-justifiable over the life of the building and -- from the electric utility's point of view -- it provides short and long-range savings.

A poorly insulated new home, on the other hand, is obsolete when constructed. Its owners face energy bills that may outpace mortgage costs. The building immediately becomes a candidate for the retrofit market -- where less savings are achievable at greater cost. Inefficient buildings usually waste energy during a utility's peak period, thus increasing costs for all electric customers.

For these reasons and others, APPA agrees that buildings must be built to be more energy efficient, and we commend the Department of Energy for its commitment to improving building energy performance standards for new construction. We support the "conservation-forcing" approach reflected in the proposed standards, and we urge DOE to keep the standards stringent. We also support the "performance" approach, which enables a designer to choose materials and methods to meet a standard level of performance.

WEIGHTING FACTORS

While the BEPS program is potentially promising, the inclusion of fuel "weighting factors" are counterproductive and in conflict with our national energy goals. The act of favoring one source of fuel over another has generated much controversy and may imperil the entire program. It would be disheartening to watch a discussion of how best to achieve "the maximum practical improvements in energy efficiency and increases in the use of

best copy available

nondepletable sources of energy" turn into a debate on the efficiencies of gas furnaces versus electric heat pumps. At worst, the entire BEPS program could be endangered by costly litigation and loss of needed support.

The application of fuel weighting factors presupposes the use of one fuel in a building over its lifetime. But changes in supply and prices are bound to occur and those changes will invalidate earlier decisions. In fact, those very changes will likely move us increasingly toward solar and renewable resources to meet space conditioning needs.

APPA believes that all buildings should be designed and constructed to be as energy efficient as practicable -- regardless of the type of heating system selected. We are opposed to the inclusion of weighting factors for the following reasons:

1. In apparent disregard for national energy policies, the weighting factors actually encourage the use of oil over electrical energy that might be produced from coal, hydro, or nuclear sources. While natural gas supplies appear adequate at the moment, the Federal government should not encourage a wasteful use of this depletable fuel by permitting a lower level of conservation in gas heated homes. In short, adoption of the standards with weighting factors as proposed appears to be in direct conflict with the national objective of less dependence on foreign sources of oil and gas. If a weighting factor is used at all for electricity from hydrogeneration, it should be set at less than one, say .25,

to recognize the tremendous difference between a Btu that comes from falling water, versus one from imported oil.

2. Weighting factors discriminate against electric utilities, against builders who wish to install electric heating systems, and against consumers who elect to use electric heating. A properly insulated home, using a zoned electric heating system, coupled with an energy storage system, may prove to be among the most efficient residential heating systems of the future. In many areas of the country, consumers would no longer have the freedom to install electric heating in buildings because of these weighting factors. Even the electric heat pump becomes a marginal alternative. Thus, APPA feels that the analysis behind the weighting factors has not been adequate and should be re-examined.

3. Weighting factors were based on national energy price forecasts published three years ago. In light of alarming price escalations (and deregulation) since that time, these projections can no longer be valid and should be reworked.

4. The margin of error that is introduced by assuming one national average for fuel cost is too great to be ignored. If regional data are not available (and we understand the Department of Labor is now collecting such information), every attempt should be made to obtain the data and integrate it into the weighting factors.

5. If BEPS is enacted in its present form there would be

several adverse implications for public power systems and their consumer-owners:

a. Public power systems make relatively heavy use of hydro power, and anticipate that this reliance will continue. BEPS is silent on the significance and the potential of this clean and desirable method of obtaining energy.

b. APPA members would have to continue to add new generating equipment to supply summer peaks. However, they would be denied the opportunity to use this capacity to supply the winter peak, because of less use of electric heating.

c. Utilities would be forced to increase reliance on older inefficient, combustion turbines built to meet summer peaks. These units generally use oil and gas. Reduction in off-peak generation needs would generally be in base-load plants that use coal and nuclear fuel.

d. The resulting reductions in overall system efficiency will raise the average unit cost of the kilowatt hours that are delivered, raising the cost of electricity to the consumer.

CONGRESSIONAL INTENT

It is the opinion of APPA that Congress, in passing the Energy Conservation Standards for New Buildings Act of 1976, did not intend to create policy on fuel use. At no point does the 1976 law authorize the establishment of different performance standards for identical buildings, based exclusively on the form of energy used, as BEPS now proposes.

IMPLEMENTATION

The process by which the BEPS program is implemented is integral to the success of the entire effort. We believe DOE should publish proposed implementation standards before trying to finalize performance standards. This would give interested parties a chance to learn how the program would function in its entirety and would give local building officials and others responsible for implementing the program a chance to comment on the standards as they relate to implementation planning.

APPA also supports the transfer of responsibility for implementing the BEPS program from the Department of Housing and Urban Development to the Department of Energy. The federal agency writing the regulations for the program should also be in a position to implement it. We support additional funding and staff capability within DOE to administer this program.

SANCTIONS

Reasonable sanctions will be needed to enforce the program. Such sanctions could include the withholding of federally supported loans for buildings that do not comply.

TECHNICAL CONSIDERATIONS

We have noted a number of technical deficiencies in DOE's background work which formed the basis for the proposed standards. We believe further consideration should be given to the following:

- Although a substantial amount of research appears to have been done on the redesign of certain building types, there is no proof that buildings constructed to the performance standard will actually save the predicted amount. If a building does not perform as expected, it may be found that improvements deemed cost-effective may not actually be cost effective. Further research is needed to correlate design energy budgets to real world consumption.

- The DOE II computer program cited in the standards should be refined. An accurate and reliable Standard Evaluation Technique is critical to the success of the BEPS program. Existing programs such as Axcess and DOE II are time-consuming and costly. Less expensive programs should be developed, so that designers can test several alternative solutions.

- The hot water energy budgets are of questionable accuracy. DOE appears to assume the same amount of energy is needed for hot water per house, regardless of climate. Similarly DOE prescribes the same energy hot water budget for five-bedroom homes as for one-bedroom homes. These assumptions should be re-examined, and justified with hard data.

- Examination of energy budgets for similar building types in a given area reveals startling anomalies. A low-rise multi-family building in Phoenix, Arizona, for example, is budgeted at 136 MBtu/sq. ft./yr. while, in the same city, 23.3 MBtu/sq. ft./yr. is the energy budget level for a single family attached home. Even including hot water, the Phoenix family is given a much lower budget.

- The proposed climatic selection procedure is not equitable to consumers outside the standard metropolitan areas. For example, a location slightly outside the Portland, Maine SMSA, could, by climatic similarity, select a budget from Minneapolis, Minnesota. The single family detached budget for electricity in Portland is 46.8 MBtu/sq. ft./yr. and in Minneapolis is 80.2 MBtu/sq. ft./yr.; a factor of almost 2 to 1.

- The use of energy budgets based on Mbtu/sq. ft./yr. could tempt designers to evade the standards by designing larger-than necessary buildings that include spaces that are only nominally "conditioned" such as porches and garages.

QUESTIONS ABOUT THE FUTURE IMPACT OF WEIGHTING FACTORS

Buildings built to do one job are almost always called upon to meet different needs of later tenants. The future contains unknown factors that will influence energy use. And, consumers have traditionally had the freedom to change heating fuels, water heaters, doors, floors and windows. What will be the effect of these later changes? By permitting a lower level of energy efficiency in gas and oil heated construction today, DOE will hasten the day when these two depletable fuels are no longer available or economical for space heating. These less efficient buildings will not be abandoned; they will be converted to electric heat, which can be generated from oil, gas, coal, hydro, shale, wood, fission or municipal waste. In fact, hopefully, many of our next generation of buildings will be heated by electricity created by fusion, solar heat, tides, fuel cells and wind power.

While experts argue on when we will run out of natural gas, all agree that we will deplete our supplies of this clean fuel in the near future. What then? Will those homes and businesses that are converting today to gas be forced to rip out their gas furnaces in a few years? Will they use those same heating systems to burn synthetic fuels? What will be the cost of future synthetic fuels? What will be the environmental cost?

When fuel supply scenarios change, the electric utility has the flexibility to change the fuel used to generate electricity, moving from gas to oil to coal. However, fuel switching is costly and difficult for the typical residential consumer at the point of use.

What are the real energy costs of the current weighting factors in BEPS? Many parts of the country do not have a natural gas distribution system. What is the cost, in net energy, of digging trenches, laying pipelines and creating new and larger gas distribution networks?

Building new gas distribution networks will also speed the day we run out of natural gas. When consumers are no longer able to get natural gas, they will turn back to oil or, more likely, to electricity.

Using electricity generated from coal and hydropower makes the best use of existing domestic natural resources. It helps decrease dependence on foreign oil and foreign liquified natural gas. Consumers who use coal, nuclear or hydro-based electricity should thus be encouraged, not penalized.

If it is sound Federal policy to support and subsidize solar energy, since solar energy decreases dependence on non-renewable resources, should not electric heating customers be rewarded for doing the same thing?

In the years to come, local public power systems will obtain energy from a variety of sources, including coal, nuclear, hydropower, wind, fuel cells, geothermal and conservation. But, the precise mix is impossible to predict.

Because each electric power system presents special considerations, blanket national weighting factors cannot be equitable. They will be even less defensible in future years.

Clearly, the answer is to set building standards as high as practicable for all new buildings regardless of fuel.

Most importantly, the inclusion of weighting factors in the BEPS plan diverts attention from the primary goals of this program: conserving important depletable resources, reducing foreign energy dependence, keeping our homes comfortable and our national economy productive.

BOSTON EDISON COMPANY
800 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02199

JOHN R. STEVENS
VICE PRESIDENT

June 10, 1980

The Honorable J. Bennett Johnston
Russell Senate Office Building (Room 421)
Washington, D. C. 20510

Dear Senator Johnston:

Attached are comments prepared for the Oversight Hearings by the Subcommittee on Energy Regulation of the Senate Energy and Natural Resources Committee which you Chair.

Thank you for the opportunity of preparing these remarks on the Proposed Rules to Implement Title III of the Energy Conservation and Production Act.

If you wish further details or have any questions pertaining to these comments, please do not hesitate to contact me.

Sincerely,

John R. Stevens

attachment

cc: Messrs. Benjamin S. Cooper
James T. Bruce

COMMENTS BY

JOHN R. STEVENS
VICE PRESIDENT, BOSTON EDISON COMPANY

ON

PROPOSED RULES TO IMPLEMENT
TITLE III OF THE
ENERGY CONSERVATION AND PRODUCTION ACT

PREPARED FOR

SUBCOMMITTEE ON ENERGY REGULATION
OF THE
SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

JUNE 10, 1980

Mr. Chairman, members of the Subcommittee on Energy and Environment, we appreciate the opportunity to submit these comments on "Proposed Building Energy Performance Standards" on behalf of Boston Edison Company. The Company supports a program for energy efficiency standards for new structures, but is concerned that the weighting factors proposed by BEPS would essentially exclude the use of electric energy for both space conditioning and water heating purposes. This would eliminate an option that could save consumers money in the installation and operation of heating and cooling systems while at the same time reducing the nation's dependence on imported oil and natural gas. In presenting our views, I would like to first review some recent Congressional actions before providing general and specific comments which concern our Company and impact our consumers.

In November 1978, Congress, in its wisdom, enacted Public Law 95-619, the National Energy Conservation Policy Act, a part of the National Energy Act. In the opening paragraphs of the NECPA, there are these significant statements: "The Congress finds that...the United States faces an energy shortage arising from increasing demand for energy, particularly for oil and natural gas, and insufficient domestic supplies of oil and natural gas to satisfy that demand." And further, "All sectors of our nation's economy must begin immediately to significantly reduce the demand for nonrenewable energy resources such as oil and natural gas..."

In August 1976, Congress, in its wisdom, enacted Public Law 94-385, the Energy Conservation and Production Act (ECPA) authorizing the Department of Energy to promulgate building energy performance standards (BEPS). With this Act, Congress issued a mandate to DOE to eliminate the waste and unnecessary consumption of energy in new buildings. The intent was to require the Department to issue regulations to encourage and require building designs which make the most efficient use of energy for heating, cooling, ventilation and for hot water requirements. On November 28, 1979, the Notice of Proposed Rulemaking appeared in the Federal Register.

One of the highlights and primary concerns with the proposed regulations is the inclusion of weighting factors applied to the energy budgets which we feel are biased against the use of this country's natural resources and the capabilities of the electric utility industry. The weighting factors according to DOE account for the difference in cost among energy types and the relative national value in conserving certain fuels. They are based on the projected 1985 price of natural gas, oil and electricity, and adjusted by adding a premium to oil and natural gas to reflect the added value of saving those fuels. More specifically, the factors are based on the relative value of different fuels to the nation expressed in terms of (1) energy prices, and (2) "explicit national policy determinations of non-market values associated with specific fuel types". Weighting factors of 2.79 for electricity, 1.22 for oil, and 1.0 for natural gas have been computed by DOE for use in preparing the comparative heating budgets for new residential structures.

These factors replace the earlier controversial Resource Utilization Factors (RUFs) and Resource Impact Factors (RIFs).

They are supposedly different and derived from a new data base. However, the new weighting factors except for some minor changes in the second decimal place are exactly the same as those used for the RJFs and RIFs, which DOE rejected as "unworkable".

The use of weighting factors is nothing more than an attempt to specify a national fuel selection procedure that dictates the increased use of imported oil and natural gas and discourages the use of electricity. These factors have no support in the ECPA or its legislative history, or in the national policies of this country. In fact, they are contrary to national energy policy.

The fundamental fallacy is classifying of electricity as a "fuel". Coal, uranium and hydro power are used to generate electricity; and it is impractical for uranium or water, and to a certain extent coal, to be used for heating buildings in any way other than through the production of electricity. DOE ignores the value of using these fuels for the generation of power as a means of attaining energy independence.

The fallacy of treating electricity as a fuel is nowhere more obvious than in DOE's use of national average prices as a basis for developing the relative weights among gas, oil, and electricity. While oil may have a relatively uniform price nationwide, electricity prices vary substantially among different regions. The price of electric power varies, among other things, depending on the costs to the individual electric utility of the fuels used for generation; the nature of its generating capacity, including the proportion of base, intermediate, and peaking capacity; its transmission configuration; its daily load shape, including the proportion of its peak and base load demand; its capital costs;

the season; the time of day, where time-of-day pricing has been instituted; and the class of customer, including the nature of metering to the customer. As a result, the use of national average electric costs by DOE produces a weight for electricity that bears no relation to its actual cost in a particular area of the country. Nevertheless, the design of every new building will be based on those fictional values if DOE's proposal becomes final. This discussion suggests the degree of complexity involved in accurately accounting for electricity prices. In developing its ration of "fuel" prices normalized on the basis of the weight for natural gas, DOE has obviously compared an orange with two kinds of apples. Such decision-making is not only unfair, but analytically unsound.

Another basic fallacy in the assumptions underlying the weighting factors relates to DOE's use of a premium in the weighting of oil and natural gas. This raises a major question about the internal inconsistency of the weighting factors. The premium was intended to place a higher weight on oil and natural gas thereby discouraging their use; yet, the relative weights after the premium is added actually discourage the use of electricity regardless of source. In adding a premium to the weights for oil and gas, DOE implicitly acknowledges the need to reduce or eliminate oil and gas use while adopting weighting factors that largely compel their consumption. In so doing, DOE defies the national energy policy directives established by Congress and the President, yet another illustration of the false policy assumptions upon which DOE's approach is based.

Still another fallacy in the assumptions underlying the weighting factors stems from the flawed policy perceptions DOE brings to the BEPS program. While DOE contends that the high cost assigned to electricity is evidence of its greater "value" to the nation, in fact value in this context is a euphemism for the opposite. DOE obviously considers the greater use of oil and gas beneficial to the nation because of the size of the weights assigned to those fuels relative to electricity. That being the case, there are a number of benefits from the consumption of electricity as well as recently developed uses of electricity that DOE has ignored in developing its reverse-value equation.

One benefit of the consumption of electricity that DOE has ignored involves greater control over environmental pollution. In discouraging the use of electricity for space heating, DOE will be encouraging on-site generation of heat in many parts of the country. While electric utilities are required to conform to the emissions standards of the Environmental Protection Agency ("EPA"), the on-site use of oil, gas, wood, or coal or on-site diesel cogeneration for space heating produces ground-level emissions that may exceed EPA standards and cannot be effectively controlled. DOE's weighting factors also ignore characteristics of electricity that encourage energy conservation. Electric resistance heating is more easily subjected to thermostatic zone control that is oil or gas. It has been estimated that a 37-percent savings in energy can result from improved in-space temperature control. DOE has not presently incorporated individual room controllability in its calculations of the weighting factors. Finally, in recent years, the design of electric heat pumps has undergone revolutionary changes that greatly increase energy savings from their use. In fact, alone among energy heating systems heat pumps can deliver at the building boundary more Btu's of energy than heat pumps consume. Nevertheless, if the proposed standards are adopted containing the weighting factors and effectively requiring the kinds of insulation with electric heat pump use that is too costly and too difficult for a designer or builder to install, the use of electric heat pumps will greatly decrease.

This discussion of the weighting factors proposed by DOE indicates that (1) Congress intended for BEPS to be a construction conservation program and not a fuels management program; (2) there is no justification for the fuel weights proposed by DOE in fact or logic; and (3) the DOE proposal will result in increased consumption of oil and gas in contravention of national energy goals. The criticisms of the assumptions underlying the weighting factors suggest that DOE has made cosmic decisions on what is good and not good for the nation on the basis of incorrect policy assumptions that are internally inconsistent and factually inaccurate. For these reasons, DOE should not include fuel weights of any kind in the energy budget levels implemented by the final rule.

With respect to Boston Edison, the BEPS weighting factors have special significance. The generation mix supplied to our customers during the year 1979 was approximately two-third residual oil fired and one-third nuclear. Our generation expansion plans call for the construction of an additional nuclear unit (Pilgrim 2) to commence within a year pending approval of the construction permit by the NRC. This will raise the nuclear component to almost 50 percent. In addition, studies are underway to convert our Mystic 4, 5 and 6 units to coal if technically, environmentally, and economically feasible. These units are presently listed by the Department of Energy as potentially coal convertible, since they were fired by coal prior to their conversion to oil approximately 15 years ago. Studies are also being conducted on the construction of a new coal-fired generating unit at our Edgar Station site in Weymouth, Massachusetts. This unit would replace oil-fired generation recently retired at this location. In summary, therefore, we are moving towards a greater reliance on nuclear and coal generation to replace residual oil both for economic reasons, security of supply, and to be consistent with national policy.

This background information is supplied simply to show that electric space heating on Boston Edison's sytem is supplied at least in part from other than oil-fired sources. Considerations of this nature are absent from DOE's proposed weighting factors. They in fact would likely promote the burning of additional amounts of oil and gas and exclude electric space conditioning contrary to national energy policy. In addition, when we examine the load characteristics of electric space heating, we find that a large share of that load is off peak, i.e. supplied during evening and weekend hours. During these time periods, the major share of electric generation in Boston Edison's case comes from nuclear-powered sources. Further, as described earlier, an even greater share of Edison's off-peak requirements will be supplied in the future via base load nuclear or coal-fired sources.

The selection of the basic heating source, for most facilities, especially in northerly climates such as New England, generally determines the energy source used for water heating and in some cases, air conditioning. Therefore, the space heating decision is especially important to utilities such as Boston Edison since water heating can also be supplied as off-peak service from nuclear and coal-fired sources.

The need to preserve the electric option becomes even more pronounced when we consider new innovations in heating and cooling which depend upon electric energy. In the case of the heat pump, which supplies more heat than the energy consumed, energy savings can be realized over oil or gas alternatives. Other innovative systems such as thermal off-peak storage, which allows energy to be stored during evening hours and released as needed, also provides a unique way to supply space conditioning and water heating using off-peak generation.

A specific benefit to electric consumers in preserving these space and water heating options is that they can elect the best system to serve their particular needs on a competitive basis. Without these options, the consumer would be restricted to the use of oil or gas, as well as the conventional systems presently utilized for the supply of heating and cooling requirements. In other words, without electric space and water heating options, the oil and gas industries would have a virtual monopoly on this market.

The benefit to the utility and to the consumer is that increased off-peak electrical usage through the use of electric space and water heating systems helps to offset the heavy fixed costs associated with base load capacity through load factor improvement. This results in lower costs to all consumers. Further, these applications make better use of transmission, distribution and other electric service facilities designed to provide for peak loads. Both of these considerations are particularly pertinent in the case of Boston Edison which is a summer peaking company.

It is for these reasons that Boston Edison and the electric utility industry take exception to the proposed BEPS weighting factors. We, as well as our industry, stand willing to assist DOE in developing logically derived energy usage factors which are technically accurate and in accord with national energy policy. Anything less would be inconsistent with Congressional intent and be a disservice to the consumers and shareholders whom we represent.

Brick Institute of America 1750 Old Meadow Road, McLean, Virginia 22102 Phone: 703-893-4010

June 5, 1980

Senator J. Bennett Johnston
Chairman, Subcommittee on Energy Regulation
3202 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senator Johnston:

I respectfully request that the attached comments be made part of the record of your June 5, 1980 subcommittee hearing on Building Energy Performance Standards (BEPS).

The Brick Institute of America, Department of Engineering and Research, has invested considerable time and effort in a most thorough review of the Department of Energy's proposed standards. Although somewhat technical, and absent the Appendix which contains several hundred pages of computer work, the conclusions represented in these comments should be of significant value to the work of your subcommittee in reviewing BEPS.

Sincerely,

John P. Gleason, Jr.

John P. Gleason, Jr.
President

JPG, Jr./mp

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Comments on

BUILDING ENERGY PERFORMANCE STANDARDS

Submitted to the
Senate Energy and Natural Resources Committee
Subcommittee on Energy Regulation

by

BRICK INSTITUTE OF AMERICA

June 5, 1981

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COMMENTS REGARDING BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

The Brick Institute of America, a trade association representing the clay brick manufacturers of the United States, would like to offer the following comments and supporting data on the Proposed Rule on Building Energy Performance Standards, Docket Number CAS-RM-79-112.

We of the brick industry are totally involved in the building industry and are therefore greatly affected by, and concerned with, the Proposed Rule, Building Energy Performance Standards, being commented on.

The brick industry, through its Institute, has advocated energy conservation by way of performance standards for building construction since long before the 1973 oil embargo. The oil embargo made us all aware of the finite nature of not only this country's fossil fuel supplies, but of the world's.

The Brick Institute of America has been, and continues to be, a pioneer in the area of passive solar design and construction. We have provided, without charge, consultation to the staff of the Department of Energy on matters relating to the commercializing of energy-efficient manufactured products. BIA has also undertaken the sponsorship of a National Passive Solar Design Competition, for undergraduate and graduate architectural students. A larger percentage of eligible students are participating in the competition than in any other similar design competition. We have a long and deep commitment to buildings that make greater use of energy resources, and to that end, we favor cost-effective energy performance standards. We have stated this position many times in our involvement with those Federal Agencies concerned with the development of energy standards, including the Department of Energy, the Department of Housing and Urban

THE NATIONAL AUTHORITY ON BRICK CONSTRUCTION

Development and the Farmers Home Administration.

We offer the following comments and backup documents for consideration by the Department of Energy prior to promulgation of the Rule.

DESIGN ENERGY BUDGET (DEB)

The Design Energy Budget (DEB) should be looked at very closely and re-evaluated based upon a broader data base. It appears from the Technical Support Documents (TSD's) that too many of the values are extrapolations from a too small data base to be technically justifiable, particularly for residential construction. There are a number of things which we have difficulty finding justification for, such as some of the budget values themselves. We compared several cities which had similar weather data found in Table II-1 of the Proposed Rule. There seems to be some rather wide spreads in the DEB's, much more so than the climatic data differences would dictate. See the tabular compilation below. These comparisons were made for climates in which heating was the prime concern, where both heating and cooling are of concern and where cooling is the prime concern.

Location	HDD 60°F Base	CDD 50°F Base	DEB			
			Single-Family Detached			Multi-Family
			Gas	Oil	Elec.	High-Rise
Phoenix, Ariz.	899	7596	29.2	30.2	30.1	131
Jacksonville, Fla.	788	6938	26.9	27.6	27.9	128
Tampa, Fla.	364	8172	28.6	28.7	30.9	129
Brownsville, Tex.	336	8753	31.6	31.8	34.5	132
Washington, D.C.	3182	4237	31.2	35.7	32.4	120
Louisville, Ky.	3584	4005	32.9	38.1	35.2	122
Albuquerque, N.M.	3234	4053	31.6	63.4	33.1	121
Amarillo, Tex.	3156	4274	30.7	35.3	31.8	120
Richmond, Va.	2916	4276	27.0	30.3	26.7	122
Minneapolis, Minn.	6842	2575	56.9	68.3	80.2	140
Great Falls, Mont.	6248	2132	45.1	54.7	59.6	129
Burlington, Vt.	6488	2180	49.1	59.6	67.5	133

Comparing Washington, D.C., to Richmond, Virginia, we see that the HDD vary by 2.4%, and the CDD vary by 0.9%. The DEB's vary as follows:

Gas	13.5%
Oil	15.1%
Electric	17.6%,

with Richmond having a much lower budget than the climatological data would indicate as justifiable. It is also very difficult to rationalize the wide spread of budget levels between Tampa and Brownsville. It is also difficult to visualize justification for Brownsville having a higher budget than does Richmond. It appears there must be a typographical error in the oil column for Albuquerque. It is difficult to rationalize the budget for oil twice that allowed for gas and electric in the same location.

The DEB's were based on computer modeling based upon the AXCESS computer program. The DEB's for buildings other than Single-Family Residences, both attached and detached, consider all site-used energy except process energy. The single-family attached and detached consider only energy required for heating and cooling the building and for heating domestic hot water. The method for determining the DEB for residential hot water heating has no rational basis and really should not be included. Hot water heating requirements are normally controlled by the number of occupants of the structure. Under the present DEB, this is not a consideration. The only consideration is a fixed budget value for each fuel type, divided by the square footage of the structure. Another thing which should be considered is the temperature of the incoming water. The incoming water temperature certainly would not be the same in Minneapolis as it is in Tampa, but the present method of determining the hot water heating budget assumes that it is. We suggest that inclusion of the hot water heating budget in the requirement will not save one Btu of energy and therefore shouldn't be included. If by its inclusion an attempt is being made to encourage the use of solar or other renewable energy sources, this could be better handled in other ways to provide this incentive.

The DEB's were set using some criteria which are not in keeping with present-day practices. The using of a Heating Degree Day base of 60°F is not in keeping with present practice, nor is the use of Cooling Degree Day to the 50°F base. Present practice and design aids are all based on a 65°F base for Heating Degree Days. Present practice does not utilize Cooling Degree Days, but rather utilizes full load cooling hours. The biggest problem with the HDD and CDD contained in the Rule is that they are not presently available to the design profession for use in specific locations not provided for in the Proposed Rule.

WEIGHTING FACTORS

The weighting factors as now included in the document are totally unrealistic and indefensible. Regional factors certainly would affect the values. This apparently was not considered. We question the validity of the basic concept of "weighting factors" - an over-simplified application a very complex subject. This is especially true in the case of electricity. There are numerous areas of the country where electricity is generated by hydro or nuclear power. These certainly shouldn't have the same weighting factors as electric generating plants using natural gas, oil, or even coal as the generating fuel. The following calculations are based on methods contained in the Rule and TSD's plus computer runs utilizing the SET and BIAECP, the Brick Institute of America's program based on steady-state and steady-periodic calculation methods. These calculations illustrate that it is virtually impossible, when applying the electricity weighting factor of 2.79, to comply with the Design Energy Budget for the Washington, D.C. area and probably most other sections of the country.

The analysis using the Brick Institute of America Energy Consumption Program (BIAECP) for the Brick System House shows that: (BEPS Report 1)

	15920 Kilowatts in the heating mode
and	3130 Kilowatts in the cooling mode
A total of	19050 Kilowatts
where	3413 Btu/kilowatt
yields	65027650 Btu per year
divided by	2496 ft^2 of heated space floor area
equals	26049 $Btu/year/ft^2$ of heated space floor area

The DOE-2 Computer Program results in a fuel consumption of 62000 $Btu/year/ft^2$ heated space floor area, when the weighting factors are applied.

The actual fuel consumption for the Brick System House, including all appliances and lighting loads, was recorded to be:

	22478 Kilowatts per year
times	3413 Btu per year
divided by	2496 ft^2 of heated space of floor area
equals	30736 $Btu/year/ft^2$ of heated space floor area.

This value included water heating, which was not included in the Brick Institute of America Energy Consumption Program, which could well account for the fact that the (BIAECP) is:

$$\frac{30736 - 26049}{30736} \times 100 = 15\%$$

lower than the actual consumption. There is no validity to the DOE-2 program run results which also do not include hot water heating, but show the fuel consumption would be:

$$\frac{62000 - 30736}{30736} \times 100 = 102\% \text{ higher}$$

than actual fuel consumption in the residence.

Now one must take into account that the 62000 Btu/year/ft^2 of floor area is adjusted with a weighting factor of 2.79 for electricity. Without the weighting factor, the energy consumption using DOE-2 would be 22222 Btu/year/ft^2 of floor area. This would appear to be a valid prediction showing that

$$\frac{30736 - 22222}{30736} \times 100 = 27\%$$

of the actual fuel consumption would be appliances, lighting, and hot water heating.

To comply with the budget for Washington, D.C., 32.4 MBtu, the level of fuel consumption, for this existing structure would have to be reduced to

$$32.4 \text{ MBtu}/2.79 = 11.6 \text{ MBtu}$$

Thus,

$$\frac{30737 - 11600}{30736} \times 100 = 63\%$$

reduction in fuel consumption would be necessary. Since there is close approximation between the result of the DOE-2, 22222 Btu per year per square foot, and BIAECP, 26049 Btu per year per square foot, the energy consumption of the Brick System House was analyzed considering all walls to be R-27, ceiling insulation at R-38, triple glazing with U = .360 and R-19 basement floor insulation (BEPS Report 2), using BIAECP. The result of the comparisons (BEPS Report 1A and BEPS Report 2) for equally oversized equipment, 20% and 100% efficiency, the Brick System House as built has an energy consumption of 27960 Kilowatts per year, which equates to 38095 Btu/year/ft^2 of floor area. The Brick System House redesigned has an energy consumption of 16420 Kilowatts per year or 22453 Btu/year/ft^2 of floor area. This is only a

$$\frac{38095 - 22453}{38095} \times 100 = 41\% \text{ reduction}$$

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and will not comply to the DOE Design Energy Budget when the weighting factor is applied:

$$33452 \text{ Btu/year/ft}^2 \times 2.79 = 62644 \text{ Btu/year/ft}^2$$

which exceeds the DEB by

$$\frac{62644 - 32400}{32400} \times 100 = 93\%$$

Thus, there should be provided here sufficient information that the DOE-2 computer program can be used to adequately estimate building energy performance, however, the design energy budget levels cannot be substantiated, using the DOE-2 or the BIAECP, nor is it known what compensating factors exist in DOE-2, i.e., whether or not some factors are negating the effects of others comparing the computer program actual condition.

Even if there is a 10% error between the DOE-2 and BIAECP, the analysis on the BIAECP would have to result in an energy consumption of

9222 Kilowatts per year, plus 10%, or
10144 Kilowatts per year, a 10531 Kilowatt per year
or a 51% additional reduction, beyond the R-27 walls,
R-38 ceiling, R-19 basement floor and triple glazing
of U = 0.36.

The analysis, using the BIAECP (BEPS Report 3) shows that for this 2496 ft^2 structure with R-40 walls, R-60 ceiling, R-30 basement floor and triple glazing, 14600 Kilowatts are required, which equates to 19964 Btu/year/ft^2. If the BIAECP is within 10% of DOE-2, this may be 17968 Btu/year/ft^2 times the weighting factor of $2.79 = 50131 \text{ Btu/year/ft}^2$, which still exceeds the 32400 Btu/year/ft^2 DEB.

From these calculations, it becomes quite apparent that when the electricity weighting factor is applied, it becomes virtually impossible to meet the DEB. Special

TABLE 1

Source	Brick System House	Blair Model Home	Woodside Type A Dogwood	Woodside Type B Cottonwood	Woodside Type D White Oak
DOE/BEPS Budget H & C	Elect. 32400	Elect. 32400	Oil & Elect. 35700	Oil & Elect. 35700	Oil & Elect 35700
DOE/BEPS Budget Hot Water Heating	Elect. 21875	Elect. 21163	Elect. 14384	Elect. 18945	Elect. 19348
DOE/BEPS Total Budget	54275	53563	50084	54645	55048
DOE-2 H & C	22222	23907	39246	47905	33131
DOE-2 H & C Weighted	Elect. 62000	Elect. 66700	Oil & Elect. 47880	Oil & Elect. 58540	Oil & Elect. 40420
BIAECP Heating & Cooling only	26049	25931	53550	37300	40707
Actual Consumption Heating	---	---	23438	31605	27231
Actual Consumption All Other (Elect.)	---	---	14191	17442	18231
Total Actual Consumption	30736	35678	37629	49047	45462

All values given in Btu/sf/yr

TABLE 2

Chicago Wall Weight	BIAECP	NBSLD	BEPS - DEB Gas	 Oil	 Electric
5 lb.	84.0	38.3	39.1	46.5	46.6
43 lb.	82.4	38.2	39.1	46.5	46.6
62 lb.	82.2	34.3	39.1	46.5	46.6
Atlanta					
5 lb.	54.4	33.5	26.3	29.1	25.7
43 lb.	51.0	33.2	26.3	29.1	25.7
62 lb.	51.3	29.0	26.3	29.1	25.7

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construction techniques would have to be developed to accommodate the huge amounts of insulation required. This would skyrocket construction cost with very little, if any, energy savings.

STANDARD EVALUATION TECHNIQUE (SET)

The Department of Energy in the Rule as now published, allows for only one method for showing compliance. This is done using a computer simulation technique, a computer program known as DOE-2. We fail to understand the justification behind setting the DEB's using the AXCESS program, but requiring that compliance must be shown using DOE-2.

One of our major concerns is that you are not allowed to show compliance with the Rule with actual performance records. Homebuilders who build repetitiously from several floor plans and have records of actual performance from fuel bills still must pay for computer runs using DOE-2, even though total fuel consumption shows the house to be well under the DEB. Table 1 for 5 different homes built in the Washington, D.C. area, vividly illustrates this. The Department of Energy must keep in mind that energy conservation is not achieved by reading the bottom line of an untried computer program which has not been verified (DOE-2). The DOE-2 runs performed by Steven Winter Associates, at the request of the Brick Institute of America, show that the homes as built in all cases exceed the DEB's when weighting factors are used. The total actual fuel consumption including not only hot water heating, but all appliances and lighting use far less energy than the DEB for heating, cooling and hot water heating. In the case of the Brick System House, the total annual consumption for everything is well under the DEB for heating and cooling 5% and 43.4% under the DEB for heating, cooling and hot water heating.

In addition to the DOE-2 runs, we ran each house on the BIAECP program developed by BIA and based on ASHRAE procedures for steady-state and steady-periodic calculation methods. In most cases the values from BIAECP were 10 to 15% above the values from the DOE-2 runs using the unweighted values. However, in the case of Type A and Type D by Woodside, the BIAECP runs were 20 to 30% above DOE-2. In the runs made on Woodside Type B, DOE-2 runs were approximately 25% above the BIAECP runs. Thus, this is believed to be a major discrepancy within the DOE-2 program. The BIAECP is based on HDD of 65°F base. The BIAECP runs and program are included in Appendix I.

One of the problems with the DOE-2 program is that it is so new that it has not been verified either by other programs in environmental chambers or by in-situ applications. The NBSLD program has been verified in the National Bureau of Standards environmental chamber using dynamic temperature conditions. BIA ran three NBSLD runs using three different wall configurations in both Atlanta and Chicago. These results are published in the Brick Institute of America Research Report 19 (see Appendix I). Table 2 shows a comparison between NBSLD, BIAECP and the DEB for single-family detached residences. Keeping in mind that the BIAECP results were with 10 to 15% of some of the DOE-2 runs, we find that the NBSLD verified program shows 40% to 60% reduction in energy consumption over the BIAECP values. All these residences using NBSLD comply for gas and oil in Chicago. None of the three comply for the electric when weighting factors are used. In Atlanta, only the heaviest wall (62 psf) using gas as the fuel complies with the DEB's.

We find that computer simulations using both DOE-2 and BIAECP, while they are fairly close in agreement, estimate energy consumption for the Washington, D.C. area far in excess of actual consumption. We knew BIAECP did, but we were not sure what DOE-2 would show. While these runs are limited in scope, it appears that a very hard look and some sort of verification of the SET (DOE 2) must be undertaken prior to implementation of the Proposed Rule.

PASSIVE AND ACTIVE SOLAR HEATING ANALYSIS

General

These comments are given Section by Section, with general references to the Proposed Rule and other Technical Support Documents.

1.0 Introduction

1.1 Background. It appears that the intent and the approach are only representative of single-family residential construction. Passive and active solar energy must be considered for commercial structures and multi-family structures. If this is not yet technically or economically feasible, the proposed Building Energy Performance Standards for New Buildings is premature and no action should be taken until such time as viable methodologies are available to determine energy performance of all building types, accurately predicting design performance levels. Also in this section the regional construction practices in the cities chosen are questioned. This is questioned because of the extreme construction variations necessary in many climatological locations to economically make solar energy heating systems viable for increasing building energy performance.

1.2 Objective. Here it is pointed out that only single-family residential buildings were considered because, as this classification is expected to experience the greatest penetration of active and passive solar measures in the near term. This is not effective reasoning because if true, this could inhibit the development of active and passive solar heating for structures other than single-family dwellings. Allowances in the SET (Standard Evaluation Technique) are thus assumed not to exist for commercial or multi-family structures. Thus, the SET is not an adequate performance standard. In addition, passive and active solar cooling seem to be nowhere addressed, again limiting the Standard Evaluation Technique to a viable solution only for what the U. S. Department of Energy deems regional construction practices, selected market areas and acceptable technology. Apparently the Department of Energy has insufficient capabilities to appropriately obtain the necessary objective for a performance standard in such a short time. The U. S. Department of Energy should seriously consider delaying the final role until such time as all of the necessary information can be adequately addressed in a Standard Evaluation Technique.

1.3 Approach. We are in agreement with statements here that "also, neither passive nor active solar cooling technologies were analyzed, due to the lack of documented and generally accepted analysis tools for these solar technologies, and their lack of market readiness". However, mandating an SET without these considerations, or without provisions for such considerations incorporated in, could greatly affect the development of such technologies and tools, to be used in the market. The document goes on to describe the reasoning behind using only one typical single-family, detached residence in the analysis. This is substantiated by ease of modification for direct gain solar measures. Performance of passive solar systems can be greatly modified for structures other than slab on grade and with other than direct gain passive solar measures, as shown in the analysis. Because of this reasoning, the information provided in this document is not acceptable because of the limitations set in the analysis. We are providing an estimation of fuel consumption with various passive solar components, direct gain and thermal storage wall systems, for a hypothetical structure, located somewhere near Washington, D.C. We provide the sizing procedures used, and also the determination of the auxiliary fuel consumption required to maintain comfortable interior temperatures for the structure, and we feel that this well demonstrates how direct gain heating systems cannot be used as a basis for determining the effective performance of passive solar energy systems. It is obvious, by taking the calculation procedures here, which use the sizing procedures that were developed by Edward Mazria Associates, and the solar load ratio procedure, developed by Los Alamos Scientific Laboratories, which were used in the document being reviewed, that the solar load ratios are the only viable solution for determining the performance of passive solar energy systems for residential structures. Unfortunately, as shown in the calculation procedures supplied here, the direct gain systems may very well not be cost-effective, and may produce no reduction in fuel consumptions when they are installed alone. The comparison of combined direct gain and thermal storage wall systems shows it to be a viable and energy-conserving structure. The result is shown in the discussion of Section 2.2.2, Heating and Cooling.

2.0 PASSIVE SOLAR ENERGY SYSTEMS

A major discussion in Section 1.0 covered most of our concerns about the methodologies and procedures

energy systems. However, we will continue providing general comments in regard to the information provided in this section, Section by Section.

2.1 Methodology. No additional comments.

2.1.1 Thermal Performance Estimation. The standard states that mass (Trombe and Mass Wall Systems) were not studied because "preliminary analysis indicated that the economic merit of properly sized direct gain systems was greater than mass wall systems". We believe that our analysis has significantly pointed out that direct gain alone, when properly sized to prevent overheating, does not supply sufficient energy performance to be a viable solution unless night insulation is used. We suggest that further studies be made on the use of combined systems, mass wall systems and direct gain systems, to come up with good passive solar design structure to be used in the analysis.

2.1.2 Optimum Passive Solar Size Determination. Although the criteria for optimally sizing the passive solar system as addressed here are necessary considerations, they do not fully address system sizing. What apparently is missing from this analysis is whether or not overheating would occur in the structure. This is not pointed out in the analysis and it is strongly suggested that this be a major consideration because if overheating is occurring, the cost of cooling the interior may greatly exceed the benefits of the heat gain supplied for heating the structure.

2.1.3 Sensitivity Analyses - The basis of the sensitivity analyses is not substantiated. There is no significant reasoning for only considering one city as the test city for the analysis. What is more important than whether or not the costs are 50% higher or 50% lower than those used as the base case, is how many can be 50% higher or 50% lower. There should be a full statistical analysis rather than a blanket statement of cost coverage. In addition operable devices for increasing performance are mentioned. Moveable night insulation is mentioned, but there are other ways of possibly even increasing performance more with or without moveable devices. Reflector panels can be used to greatly increase performance at minimal cost increase. Operable shading devices in lieu of fixed shading devices can also increase performance substantially with minimal cost increase. In addition, there are many other areas, such as hybrid systems, which are passive solar energy systems assisted by small mechanical equipment, such as fans and blowers. These areas are not addressed, and should have been addressed in the sensitivity analyses in order that this become a proper and useable document for substantiating the performance and economics of passive solar energy systems.

2.2 Assumptions

2.2.1 Base House Characteristics. Under the section "Glazings", it is not representative of actual building costs to assume that passive solar glazings are added to the 15% glazings assumed in the base house. The minimal requirement would be the amount of passive solar glazings added to the amount in the base house minus the portion of glazing that would have been on the south wall to come up with an accurate account for the additional costs of the glazing. Also, by adding the passive solar glazings into it, without taking into account the amounts that are being replaced on the south wall, the heat loss of the structure is higher in the analysis. Internal thermal mass in this section is pointed out that more than just slab on grade construction was considered and we are supportive of this concept as it represents actual construction practices in various regions throughout the United States.

2.2.2 Heating and Cooling Loads - As stated earlier, the passive solar energy systems are basically a new market. The document points out that the heating loads used in this study were derived from the results of the conservation analysis. If the conservation analysis is based on the SET, then the information provided for the use in the SLR procedure is not a viable relationship. The SLR procedure is based on steady-state performance calculations. If the SET were used for conservation analysis and is not strictly in compliance with steady-state claculation procedures, then this analysis is not valid.

Consider the evaluation of a 1500 ft^2 structure near Washington, D.C., at 40° North Latitude, insulated floor over a crawl space, shows:

Roof/Ceiling 1500 ft^2 x 0.033 $Btu/hr/^\circ F/ft^2$ = 49.5 $Btu/hr/^\circ F$

Doors 40 ft^2 x 0.365 $Btu/hr/^\circ F/ft^2$ = 14.6 $Btu/hr/^\circ F$

Windows 132 ft^2 x 0.690 $Btu/hr/^\circ F/ft^2$ = 92.1 $Btu/hr/^\circ F$

Opaque Wall 708 ft^2 x 0.050 $Btu/hr/^\circ F/ft^2$ = 35.4 $Btu/hr/^\circ F$

Direct Gain Glazing	$400\ ft^2 \times 0.690\ Btu/hr/^\circ F/ft^2 =$	$276.0\ Btu/hr/^\circ F$
Floor	$1500\ ft^2 \times 0.050\ Btu/hr/^\circ F/ft^2 =$	$\underline{75.0\ Btu/hr/^\circ F}$
Sub Total		$342.6\ Btu/hr/^\circ F$
Infiltration	$= 0.60$ air changes/hr $\times\ 0.018\ Btu/^\circ F/ft^3 \times 1200\ ft^3 =$	$\underline{129.6\ Btu/hr/^\circ F}$
Total		$672.2\ Btu/hr/^\circ F$

Daily Heat Loss = $672.2\ Btu/hr/^\circ F \times 24\ hr = 15133\ Btu/day/^\circ F$

Approximately $10.1\ Btu/day/^\circ F/ft^2$ of floor area

Required Glazing = $\frac{10.1}{8.0} \times 0.17 \times 1500\ ft^2 = 321.3\ ft^2$

Roof/Ceiling	$1500\ ft^2 \times 0.033\ Btu/hr/^\circ F/ft^2 =$	$49.5\ Btu/hr/^\circ F$
Doors	$40\ ft^2 \times 0.365\ Btu/hr/^\circ F/ft^2 =$	$14.6\ Btu/hr/^\circ F$
Windows	$132\ ft^2 \times 0.690\ Btu/hr/^\circ F/ft^2 =$	$40.4\ Btu/hr/^\circ F$
Opaque Walls	$808\ ft^2 \times 0.050\ Btu/hr/^\circ F/ft^2 =$	$107.0\ Btu/hr/^\circ F$
Direct Gain Glazing	$300\ ft^2 \times 0.690\ Btu/hr/^\circ F/ft^2 =$	$107.0\ Btu/hr/^\circ F$
Floor	$1500\ ft^2 \times 0.050\ Btu/hr/^\circ F/ft^2 =$	$\underline{75.0\ Btu/hr/^\circ F}$
Sub Total		$478.6\ Btu/hr/^\circ F$
Infiltration		$\underline{129.6\ Btu/hr/^\circ F}$
Total		$608.2\ Btu/hr/^\circ F$

Daily Heat Loss = $608.2\ Btu/hr/^\circ F \times 24\ hr = 14597\ Btu/day/^\circ F$

approximately $9.7\ Btu/day/^\circ F$ of floor area

Required glazing = $\frac{9.7}{8.0} \times 0.17 \times 1500\ ft^2 = 308.5\ ft^2$

By following the worksheets on the next two pages, using the format provided in Technical Notes 43B, the Auxiliary Heating Requirements of the direct gain system analyzed is 57.3 million Btu per year, or 38.2 thousand Btu per square foot of building floor area for the heating season.

Consider the relationship of the heating requirements to a conventional structure by replacing the south wall direct gain system with opaque wall and 15% glazing in the south wall.

Roof/Ceiling	1500 ft^2 x 0.33 Btu/hr/^{o}F/ft^2 =	49.5 Btu/hr/^{o}F
Door	40 ft^2 x 0.365 Btu/hr/^{o}F/ft^2 =	14.6 Btu/hr/^{o}F
Windows	192 ft^2 x 0.690 Btu/hr/^{o}F/ft^2 =	132.5 Btu/hr/^{o}F
Opaque Wall	1048 ft^2 x 0.050 Btu/hr/^{o}F/ft^2 =	52.4 Btu/hr/^{o}F
Floor	1500 ft^2 x 0.050 Btu/hr/^{o}F/ft^2 =	75.0 Btu/hr/^{o}F
Sub Total		324.0 Btu/hr/^{o}F
Infiltration		129.6 Btu/hr/^{o}F
Total		453.6 Btu/hr/^{o}F

Daily Heat Loss = 453.6 Btu/hr/^{o}F x 24 hr = 10886 Btu/day/^{o}F

Gross Annual Heat Loss = 10886 Btu/day/^{o}F x 6916 degree days = 75.3 million Btu

Net Annual Heat Loss = 75.3 - 21.9 = 53.4 million Btu

The viable design solution would be to use combined passive solar energy systems.

Roof/Ceiling	1500 ft^2 x 0.033 Btu/hr/^{o}F/ft^2 =	49.5 Btu/hr/^{o}F
Door	40 ft^2 x 0.365 Btu/hr/^{o}F/ft^2 =	14.6 Btu/hr/^{o}F
Windows	132 ft^2 x 0.690 Btu/hr/^{o}F/ft^2 =	92.1 Btu/hr/^{o}F
Opaque Wall	708 ft^2 x 0.050 Btu/hr/^{o}F/ft^2 =	35.4 Btu/hr/^{o}F
Direct Gain Glazing	200 ft^2 x 0.050 Btu/hr/^{o}F/ft^2 =	138.0 Btu/hr/^{o}F
Thermal Storage Wall System	200 ft x 0.0227 Btu/hr/^{o}F/ft^2 =	45.4 Btu/hr/^{o}F
Floor	1500 ft^2 x 0.117 Btu/hr/^{o}F/ft^2 =	75.0 Btu/hr/^{o}F
Sub Total		450.0 Btu/hr/^{o}F

DIRECT GAIN ONLY

DETERMINATION OF AUXILIARY HEATING REQUIREMENTS

Month	DD	C_{DD}	DD_A	GHHL Btu $\times 10^6$	IHG Btu $\times 10^6$	NHHL Btu $\times 10^6$	SRA Btu $\times 10^6$	SLR	SHF	HSS Btu $\times 10^6$	AHR Btu $\times 10^6$
Jan	1020	217	1237	18.1	2.5	15.6	4.8	0.31	0.17	2.7	12.9
Feb	874	196	1070	15.6	2.2	13.4	4.8	0.36	0.20	2.7	10.7
Mar	719	217	936	13.7	2.5	11.2	4.8	0.43	0.25	2.8	8.4
Apr	357	210	567	8.3	2.4	5.9	3.8	0.64	0.40	2.4	3.5
May	131	217	348	5.1	2.5	2.6	2.9	1.12	0.62	1.6	1.0
Sept	43	210	253	3.7	2.4	1.3	4.5	3.46	0.97	1.3	0.0
Oct	291	217	508	7.4	2.5	4.9	5.6	1.14	0.63	3.1	1.8
Nov	609	210	819	12.0	2.4	9.6	4.9	0.51	0.30	2.9	6.7
Dec	961	217	1178	17.2	2.5	14.7	4.3	0.29	0.16	2.4	12.3
Total	5005	1911	6916	101.1	21.9	79.2				21.9	57.3

≈28%

DIRECT GAIN ONLY

DETERMINATION OF SOLAR RADIATION ABSORBED

Month	H Btu/ft^2	D	C_H	C_G	C_O	C_T	C_S	C_R	α	NSCA ft^2	SRA Btu x 10^6
Jan	17732	-21.4	1.19	1.00	1.00	1.00	1.00	1.00	0.85	270	4.8
Feb	22828	-14.0	0.96	1.00	1.00	1.00	0.95	1.00	0.85	270	4.8
Mar	34875	-2.8	0.66	1.00	1.00	1.00	0.90	1.00	0.85	270	4.8
April	43767	9.1	0.43	1.00	1.00	1.00	0.85	1.00	0.85	270	3.8
May	53261	18.6	0.30	1.00	1.00	1.00	0.80	1.00	0.85	270	2.9
Sept	40200	2.8	0.54	1.00	1.00	1.00	0.90	1.00	0.85	270	4.5
Oct	31118	-9.1	0.82	1.00	1.00	1.00	0.95	1.00	0.85	270	5.6
Nov	19527	-18.6	1.10	1.00	1.00	1.00	1.00	1.00	0.85	270	4.9
Dec	14914	-23.1	1.25	1.00	1.00	1.00	1.00	1.00	0.85	270	4.3

Infiltration	129.6 Btu/hr/°F
Total	579.6 Btu/hr/°F

Daily Heat Loss = 579.6 Btu/hr/°F x 24 hr = 13910 Btu/day/°F

The annual auxiliary heating requirements with combined direct gain and thermal storage wall systems is 45.2×10^6 or 8.2×10^2 Btu less than that of the conventional structure with consideration of the internal heat generation. Without the consideration of internal heat generation in the conventional structure (which is accepted practice), the heating load is approimxately 40% less for the passive solar structure than for the conventional structure.

Continuing with the previous analysis, the cost of a structure using direct gain glazing alone would be:

$300\ ft^2 \times \$\ 6.50/ft^2 = \$1,950.00$

$300\ ft^2 \times\ 10.00/ft^2 = \underline{3,000.00}$

$\$4,950.00$

Less credit for wall replaced 600.00 = $4,350.00 without any energy conservation occurring, but actually an increase in fuel consumption of approximately 7%. The combined systems again using the costs provided in the Technical Support Document (TSD) would be:

$400\ ft^2 \times \$\ 6.50/ft^2 = \$2,600.00$

$200\ ft^2 \times\ 10.00/ft^2 = 2,000.00$

$200\ ft^2 \times\ 8.00/ft^2 = \underline{1,600.00}$

$\$6,200.00$

Less credit for wall replaced 800.00 = $5,400.00, with energy consumption decreased by 8.2×10^6 Btu per year, or approximately 15% reduction in fuel consumption when comparing the performance of the structure with the passive solar components to that of a conventional structure.

COMBINED SYSTEMS

DETERMINATION OF AUXILIARY HEATING REQUIREMENTS

th	DD	C_{DD}	DD_A	GHHL Btu x10	IHG Btu x10	NHHL Btu x10	SRA Btu x10	SLR	SHF	USS Btu x 10^6	AHR Btu x 10^6
n	1020	217	1237	17.2	2.5	14.7	3.2	0.22	0.13	1.9	TOTALS LISTED ON THE NEXT SHEET.
b	874	196	1070	14.9	2.2	12.7	3.2	0.25	0.15	1.9	
r	719	217	936	13.0	2.5	10.5	3.2	0.30	0.17	1.8	
r	357	210	567	7.9	2.4	5.5	2.4	0.44	0.25	1.4	
y	131	217	348	4.8	2.5	2.3	2.0	0.87	0.52	1.2	
pt	43	210	253	3.5	2.4	1.1	3.0	2.73	0.95	1.0	
t	291	217	508	7.1	2.5	4.6	3.7	0.80	0.58	2.7	
ov	609	210	819	11.4	2.4	9.0	3.3	0.37	0.21	1.9	
ec	961	217	1178	16.4	2.5	13.9	2.9	0.21	0.12	1.7	
otal	5005	1911	6916	96.2	21.9	74.3					

COMBINED SYSTEMS

DETERMINATION OF AUXILIARY HEATING REQUIREMENTS

Month	DD	C_{DD}	DD_A	GHHL Btu $\times 10^6$	IHG Btu $\times 10^6$	NHHL Btu $\times 10^6$	SRA Btu $\times 10^6$	SLR	SHF	(TOTAL) USS Btu $\times 10^6$	AHR Btu $\times 10^6$
Jan	1020	217	1237	17.2	2.5	14.7	3.2	0.22	0.13	(3.8) 1.9	10.9
Feb	874	196	1070	14.9	2.2	12.7	3.2	0.25	0.15	(3.8) 1.9	8.9
Mar	719	217	936	13.0	2.5	10.5	3.2	0.30	0.17	(3.6) 1.8	6.9
Apr	357	210	567	7.9	2.4	5.5	2.4	0.44	0.25	(2.8) 1.4	2.7
May	131	217	348	4.8	2.5	2.3	2.0	0.87	0.45	(2.2) 1.0	0.1
Sept	43	210	253	3.5	2.4	1.1	3.0	2.73	0.86	(1.1) 0.9	0.0
Oct	291	217	508	7.1	2.5	4.6	3.7	0.80	0.42	(4.6) 1.9	0.0
Nov	609	210	819	11.4	2.4	9.0	3.3	0.37	0.21	(3.8) 1.9	5.2
Dec	961	217	1178	16.4	2.5	13.9	2.9	0.21	0.12	(3.4) 1.7	10.5
Total	5005	1911	6916	96.2	21.9	74.3				29.1	45.2

COMBINED SYSTEMS

DETERMINATION OF SOLAR RADIATION ABSORBED

Month	H Btu/ft²	D	C_H	C_G	C_O	C_T	C_S	C_R	α	NSCA ft²	SRA Btu x 10^6
Jan	17732	-21.4	1.19	1.00	1.00	1.00	1.00	1.00	0.85	180	3.2
Feb	22828	-14.0	0.96	1.00	1.00	1.00	0.95	1.00	0.85	180	3.2
Mar	34875	-2.8	0.66	1.00	1.00	1.00	0.90	1.00	0.85	180	3.2
April	43767	9.1	0.43	1.00	1.00	1.00	0.85	1.00	0.85	180	2.4
May	53261	18.6	0.30	1.00	1.00	1.00	0.80	1.00	0.85	180	2.0
Sept	40200	2.8	0.54	1.00	1.00	1.00	0.90	1.00	0.85	180	3.0
Oct	31118	-9.1	0.82	1.00	1.00	1.00	0.95	1.00	0.85	180	3.7
Nov	19527	-18.6	1.10	1.00	1.00	1.00	1.00	1.00	0.85	180	3.3
Dec	14914	-23.1	1.25	1.00	1.00	1.00	1.00	1.00	0.85	180	2.9

ECONOMICS

The Department of Energy based all of their cost-effectiveness studies on a 30-year life cycle. We question the validity of this life cycle on at least three (3) counts.

First, we question anyone's ability to predict fuel costs accurately over the next five years, let alone thirty years. Secondly, in the present-day money market, it is difficult to predict money costs on a day-to-day basis, let alone thirty years. Thirdly, maintenance of some of the energy-conserving systems will be required long before the thirty-year period expires, and we feel that maintenance and replacement costs must be included in any cost-effectiveness study for it to be meaningful and useful.

Examination of the Rule and the TSD's indicate to us that high levels of insulation and other energy-saving procedures, which may be of questionable value in conserving energy, were given maximum benefits in the study, while thermal mass and passive solar were, at least, inadequately addressed. Also, initial additional costs of insulation and other energy conservation systems were minimized, while costs used in passive solar systems were greatly exaggerated on the high side. Maintenance costs of mechanical systems were ignored.

In our experience, furnaces usually require replacement at about 15 to 20 years into the life of the house. Control air conditioning units usually requirement complete replacement after about 15 years, after replacement of the compressor between 5 and 10 years. If hot water heating is to be considered as part of the budget, against our wishes, then replacement is required about every 5 to 8 years.

We suggest that the Department of Energy closely examine the Economics Technical Support Document in light of the aforementioned points, and make the necessary adjustments in their further study of the cost-effectiveness of the Proposed Rule. There are some very serious questions which the Department of Energy must address or the building owner (as much of what was said applies to buildings other than residential) will be forever trying to recover initial costs and maintenance costs from energy cost savings.

We strongly suggest that the Department of Energy consider the information developed using the NBSLD contained in NBSIR 79-1789, Economical Analysis of Insulation in Selected Masonry and Wood-Frame Walls, which has shown that for wood-frame construction, the maximum cost-effective insulation value is R-11 for 55°F base heating degree days between 500 and 1500. It also points out that in the range from 2000 degree days to 7000 degree days, the maximum R-value to be cost-effective is R-18. It should be noted that these levels of cost-effectiveness are based on the U. S. Department of Energy fuel cost projections for 30 years, values less than the Means Construction Costs, and at only a 10% interest rate for initial and additional investment. These values are in great discrepancy with the values developed by the Department of Energy for the Building Energy Performance Standard. Clarification for such differences is warranted and must be done prior to implementation of such a standard, especially when the values used for the National Bureau of Standards were so conservative and in no way reflect current fuel costs or interest rates.

CONCLUSION

When Congress mandated the performance approach, we assumed their intent was to conserve energy by way of a rational, technically sound and workable document within a given time frame. The document, as now published, does not completely fill this bill. We feel the primary reason for this is due to the time frame mandated and the complexity of the assigned task. We feel that the time has come for the Department of Energy to explain the problems to the Congress and ask for an extension of time in which to develop a document such as was envisioned by the Congress at the time they passed the law.

An extension of time would enable the Department of Energy to check out the DOE-2 program to determine if it is a valid Standard Evaluation Technique and if it is not, to select a methodology which is. It would also enable the Department of Energy to broaden the data base used in determining the Design Energy Budgets and to make revisions to them, based upon sound, technical data. An extension of time would also allow the Department of Energy to adequately address the written comments and the testimony from the hearings and incorporated these into a rational, sound, workable document. We fear that if these things are not done, which is virtually impossible within the present time frame, the final Rule will be a piecemeal document, and could possibly be counter-productive as far as energy conservation is concerned.

In light of these facts, we at the Brick Institute of America recommend to the Secretary of the Department of Energy, and will also recommend to the Congress, that the Department of Energy carefully study and respond to the comments received in the review process, and that suitable revisions and modifications be made to the proposed Building Energy Performance Standard and the Technical Support Documents, and that the resulting revised standard be coordinated in a logical, rational package. These must then be returned to the public to study and provide comments. After such a review, or simultaneously with it, the new standard should be instituted as a voluntary standard for a period of two or three years for full evaluation before it is made mandatory. This is the only way that it can be truly judged.

Brick Institute of America

jcr

Gardner S. McBride
Executive Vice President

BUILDING
OWNERS
AND
MANAGERS
ASSOCIATION
INTERNATIONAL

1221
Massachusetts Ave. NW
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20005

202-638-2929

BOMA
INTERNATIONAL

June 26, 1980

The Honorable J. Bennett Johnston
Chairman, Energy Regulation Subcommittee of the U.S. Senate
Energy and Natural Resources Committee
3106 Dirksen Office Building
Washington, D.C. 20510

Dear Mr. Chairman:

The Building Owners and Managers Association International (BOMA) presents herein its written testimony to your Subcommittee on the Department of Energy's proposed Building Energy Performance Standards. BOMA requests that its testimony be included in the Subcommittee's record of the June 26, 1980 hearings held regarding BEPS.

As stated in our testimony, it is BOMA's position that the DOE needs and should be granted a two-year extension to improve and perfect BEPS.

Please direct any questions you may have to me at (202) 638-2929.

Thank you.

Sincerely,

Gardner McBride

Gardner S. McBride
Executive Vice President
BOMA International

BUILDING
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AND
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BOMA
INTERNATIONAL

TESTIMONY OF
BUILDING OWNERS AND MANAGERS ASSOCIATION INTERNATIONAL
ON DOE'S PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS

SUBMITTED JUNE 25, 1980
TO THE SENATE SUBCOMMITTEE ON ENERGY REGULATION
FOR INCLUSION IN
THE HEARING RECORD OF JULY 26, 1980

The Building Owners and Managers Association International (BOMA) has a profound interest in the Building Energy Performance Standards (BEPS) currently being developed by the Department of Energy. As the representative of the high rise office building industry, whose energy costs comprise its largest controllable expense, we have an obvious desire to cut energy consumption in office buildings. As the representative of an industry whose members share a deep concern over our nation's present unacceptable reliance on foreign oil, we feel obligated to join in the battle for energy independence. And as the representative of owners and managers of nearly a billion square feet of office properties, we recognize that by following reasonably drawn design standards the office building industry can save an enormous amount of energy.

Since 1973, our members have reduced energy consumption dramatically, as documented in our reporting to DOE'S Voluntary Business Energy Conservation Program. But we recognize that more needs to be done. Therefore, BOMA strongly supports the development of a performance based design standard. However, prior to the building community's lending its support to a final Building Energy

Performance Standard (BEPS), the standard must be both technologically sound and economically justifiable. BEPS, as currently proposed, is neither, and we hope Congress will approve the recommendations of both its chambers' banking committees to delay the implementation of BEPS by two years until August, 1982.

During the delay, DOE should improve and perfect its BEPS program, develop a prescriptive alternative and initiate demonstration projects to confirm that its proposal is actually headed down the road of technically sound, economically justifiable energy conservation.

But at present BEPS is unworkable. There are several major problems in it which leave the program fatally flawed:

1) BEPS has yet to be economically justified. DOE has based BEPS on antiquated design practice rather than the currently accepted design standard, estimated life cycle costs only for single family residences and relied on inadequate computer simulations of energy savings.

2) No prescriptive alternative has been included. Before BEPS, a mandated performance standard, takes effect, a prescriptive alternative must be designed

and made available. BOMA is aware and pleased that DOE has followed a suggestion made by us and others and plans to develop such a prescriptive, "cookbook" alternative.

3) The elements of the proposed design standard do not share a common methodology. The Energy Budget Levels (EBLs) should be derived from the Standard Evaluation Technique (SET), but they are not under the proposed BEPS plan. Instead, DOE has developed a complicated, sophisticated -- but totally invalid -- comparability procedure.

4) The proposed weighting factors are inappropriate. In developing its weighting factors, DOE has not only superceeded its legislative authority by advocating a fuel use policy, but has also favored the increased consumption of oil, the scarce energy source which the nation must reduce its dependence upon, instead of encouraging the use of electricity, a domestic, more abundant energy source.

5) The DOE-II computer model upon which the Standard Evaluation Technique (SET) is centered must be validated, made available commercially, realistically simulate the full range of building design practice and allow for innovation.

BOMA has offered solutions to these problems to make BEPS technologically sound and economically feasible. These solutions, and further discussion of the problems, are contained in BOMA's testimony at the Washington D.C. public hearing DOE held on BEPS. A copy of our testimony is enclosed.

Besides the additional time DOE will need for revision of BEPS, it is imperative that the plan be adequately tested before it is put into effect. When implemented, BEPS will have an enormous impact both in economic costs to building owners and energy savings to the nation. Neither the nation nor the office building industry can afford to undertake such a far-reaching program if we are unsure of either its workability or whether its intended goals will actually be reached. BOMA notes that Dr. Maxine Savitz, assistant secretary for conservation and solar energy, has already stated before the Subcommittee DOE's intent to go ahead with a field testing program for BEPS, and we hope sufficient attention will be paid in these studies to the impact BEPS will have on the office building industry.

For all the above reasons -- to perfect what BOMA sees now as a technically flawed program, to develop a prescriptive alternative, to test out its proposals -- it is evident that DOE will need a considerable amount of time before it can present a BEPS program which will work in the best interest of the nation and also win the support of the office building industry. BOMA feels a two-year extension, as recommended by the House and Senate Banking Committees, is sufficient and reasonable, and hopes that the Subcommittee will concur.

Thank you for the opportunity to present our testimony. If you have any questions or desire additional information, please contact Gardner McBride at (202) 638-2929.

Enclosure

ardner S. McBride
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BOMA
INTERNATIONAL

STATEMENT OF

BUILDING OWNERS AND MANAGERS ASSOCIATION INTERNATIONAL

ON

DOE'S PROPOSED

BUILDING ENERGY PERFORMANCE STANDARDS

PRESENTED BY GARDNER S. McBRIDE
EXECUTIVE VICE PRESIDENT, BOMA INTERNATIONAL

SUBMITTED MARCH 24, 1980
GEORGETOWN UNIVERSITY
HALL OF NATIONS
36TH AND PROSPECT STREETS, NW
WASHINGTON, D.C. 20008

BUILDING OWNERS AND MANAGERS ASSOCIATION INTERNATIONAL
STATEMENT ON DOE'S PROPOSED
BUILDING ENERGY PERFORMANCE STANDARDS

MARCH 24, 1980

OUTLINE

1. Introduction of BOMA International and its qualifications.
2. BOMA criteria used to judge BEPS: technical soundness and economic justification.
3. The Five Categories reviewed by criteria:
    1. Justification
    2. Performance/Prescriptive Alternatives
    3. Energy Budget Levels
    4. Weighting Factors
    5. Standard Evaluation Technique
4. Conclusion: BEPS is not technically sound nor economically justified as drafted.

BOMA INTERNATIONAL QUALIFICATIONS

My name is Gardner McBride and I am the Executive Vice President of the Building Owners and Managers Association International (BOMA). Our association represents the owners and managers of nearly a billion square feet of office properties. We have collected data on member buildings for 60 years and were the only property based association to participate in the U.S. Department of Energy's Voluntary Business Energy Conservation program starting in 1977. At that time our industry was able to demonstrate savings of over 28% compared to a base year of 1973. Further improvements in energy conservation followed in 1978 and 1979.

Clearly, BOMA's membership has a major stake in the proposed Building Energy Performance Standards, and my intention today is to present BOMA's position on energy conservation and federal regulation, along with our analysis of the BEPS program.

Nowhere is the United States government's objective to conserve energy more warmly received than in the office building industry. There is a clear awareness of energy's vital role in underpinning our nation's economy and in assuring the national security. During the current transition period, it is essential for conservation to stretch existing energy supplies. However, conservation also plays a more immediate role than just long term self-interest. Energy is the largest controllable expense of BOMA's membership, whose annual energy bill runs well over a billion dollars -- making conservation necessary for survival in a competitive marketplace.

BEPS SHOULD BE TECHNICALLY SOUND AND ECONOMICALLY JUSTIFIABLE

In talking to members across the country, I've encountered a pervasive faith in the ability of the marketplace to allocate scarce resources -- when allowed. On the other hand, I've been struck by the groundswell of antagonism toward additional federal regulation. Members attribute inflation to deficits covered by printing money, as rising taxes are dwarfed by government spending on ballooning transfer payments, and on still more federal regulation whose effect is to stifle productive business. I believe this represents a growing awareness on the part of an electorate who are beginning to raise healthy questions about the desirability of additional intrusion into people's affairs by the Federal Government.

However, there do remain areas where government action is appropriate. Considering the national priority of energy conservation, a performance-oriented building energy standard makes a lot of sense -- if, but only if, it is both technically sound, and economically justifiable. The consensus of the building community is that the current version of BEPS is neither, and this negative consensus is particularly significant since willing support is essential to achieve realistic conservation.

Before addressing some major flaws in BEPS, and proposing remedies, I would like to state for the record that BOMA International is much impressed by the talent and expertise which DOE has invested to develop a sophisticated performance standard. The technical support documents are extensive and meaningful, and attempt to address nearly every substantive objection to BEPS. The several fatal flaws BOMA feels must be remedied in the program result from the ambitiousness of the goal, the complexity of the subject, and economic and technological restraints.

FIVE CATEGORIES REVIEWED BY CRITERIA

As I focus my comments directly on BEPS, I intend to review five categories:

Justification, Performance/Prescriptive Alternatives, Energy Budget Levels, Weighting Factors, and the Standard Evaluation Technique.

JUSTIFICATION. A regulation such as BEPS, which imposes billions of dollars of added costs, must have clear and compelling economic justification -- not only for legal sufficiency, but also to obtain the cooperation and support of the building industry. DOE's formal economic justification relies solely on computer simulations of energy savings. Life cycle costs, taking into account a standard set of conservation measures, were estimated for only four prototype single family residences. 168 commercial buildings and multi-family residences, which started construction in 1975 or 1976, were redesigned according to 1978 practice to estimate potential savings.

However, the baseline against which BEPS should be judged is not 1974 design practice, but an updated version of ASHARE Standard 90-75, the current generally accepted design standard. By choosing a pre-ASHARE 90-75 baseline, the effect of 90-75 itself may be erroneously counted toward BEPS justification. Valid justification of BEPS requires comparing the results of applying the Standard Evaluation Technique, by SMSA, to prototype buildings adhering to 90-75, then redesigned to a stricter successor to 90-75, and finally redesigned for maximum justifiable conservation. Only then can we determine if economic justification exists for introduction of a building energy performance standard. BOMA is openminded but suspects that the justification will not exist and is unwilling to assume that it does.

PERFORMANCE/PRESCRIPTIVE ALTERNATIVES. BOMA applauds the choice of performance regulations, which allow designers the freedom to address the complex and unique trade-offs involved in optimally designing any given building. However, performance regulations entail considerable investment in expertise and sophistication that cannot realistically be expected to be universally available. Therefore, it is absolutely essential to develop a prescriptive alternative, such as a modified 90-75 -- which is already widely practiced and respected.

This approach of combining alternative performance and prescriptive regulations is also being taken in a model plan, sponsored by BOMA International, to conserve energy in existing buildings under the Emergency Energy Conservation Act of 1979. Only such an approach can combine the requirements of simplicity (through the prescriptive alternative) and flexibility (through the performance alternative).

ENERGY BUDGET LEVELS. BOMA recognizes BEPS as a design standard, using the standard Evaluation Technique (SET) to calculate the Design Energy Consumption (DEC), which is compared against the Design Energy Budget (DEB), which is derived from the Energy Budget Levels (EBL). While it is useful for the Design Energy Consumption to reasonably anticipate actual energy consumption, it is absolutely imperative that each element of the design standard be directly comparable with each other. This means that to achieve nominal comparisons between alternative design, the SET, DEC, DEB, and EBLs must all arise from a common methodology.

As currently proposed, BEPS fails this test. The SET, which should be the common denominator by which BEPS is made internally consistent, was not used to develop the EBLs. Rather, energy consumption of 168 redesigned buildings simulated with the AXCESS model, was processed by elaborate "comparability adjustment" regressions to estimate redesigned consumption for the 1,661 building sample. This sample was used in heating and cooling degree day regressions to establish EBLs by SMSA.

This elaborate and sophisticated procedure is interesting, but wholly invalid. First, the Design Energy Budget calculated from the Energy Budget Level is not comparable to the Design Energy Consumption calculated from the Standard Evaluation Technique. Second, the elaborate mesh of interwoven assumptions cannot hold water. For example, if EBLs are indeed functions of annual heating and cooling degree days only, independent of humidity, wind, solar radiation, and diurnal effects as claimed, then not only is all previous load research in error, but it is indefensible to require the SET to simulate all weather variables, and on an hourly basis.

To generate valid EBLs, the SET should be used, for each SMSA, on two classes of buildings. The first class would consist of each of the 168 redesigned buildings certified as appropriate for that SMSA. The second class would consist of prototypes designed to a successor of 90-75, as mentioned earlier. The results from the two classes would serve as vital consistency checks on one another, and intermediate values should be selected as EBLs.

WEIGHTING FACTORS. BOMA recognizes the need to conserve fuel, not merely reduce site energy consumption. This implies the need for some form of weighting factors. However, the intense and justifiable opposition to the current weighting factors is due to four facts: first, they encourage increased dependence on imported oil; second, they do not reflect marginal prices; third, they do not incorporate regional differences; and fourth, they do not take into account the fuel used to generate electricity.

DOE should recalculate the weights based on marginal prices, and include other fuels such as coal, steam, and chilled water. DOE should also dramatically increase the premium associated with oil. As an example, Stobaugh and Yergir, in *Energy Future*, estimate the price effect of incremental oil imports by the U.S. due to direct demand-induced price changes, balance of payments effects on the GNP, and corresponding policies in other nations. Their figures would imply a revision in the weighting factor of electricity from 3.08 to 1.7.

In addition, DOE should establish explicit *credits* for renewable resources such as hydroelectric and biomass, and non-depletable resources such as coal.

Finally, each electric utility should be allowed to annually calculate its own weighting factor, using its incremental fuel costs adjusted by apporpriate premiums or credits as determined by its fuel mix. This would clearly further the US policy encouraging electric utilities to convert from oil to secure domestic resources.

STANDARD EVALUATION TECHNIQUE (SET). The SET is centered on the DOE-II computer model, which is undergoing accelerated development and validation. It is essential that DOE-II be thoroughly validated, available commercially, capable of realistically simulating the full range of building design practice, and that reasonable alternative evaluation techniques be approved, all *well before* any effective data for BEPS.

Considering the fact that innovative design practices will always outpace standardized simulations, credit should be allowed for energy conservation measures incapable of simulation by the SET. This energy credit should either be calculated by an alternative engineering analysis, or simply inferred from its capital investment by a nominal ROI. This approach will explicitly futher DOE's stated policy of encouraging innovation in energy conservation.

Finally, a valuable enhancement to DOE-II could be to make available a report which critiques the modeled building relative to prototype buildings designed to a modified ASHARE 90-75 code, as mentioned earlier. By maintaining a data base by SMSA, of prototype building simulation results for various energy design categories (such as envelope, lights, or HVAC system), the design professional would have available a powerful tool by which to focus on specific areas of buildings with redesign potential.

CONCLUSION

To summarize my position, and that of BOMA International, our analysis of BEPS has resulted in considerable respect for DOE's sophisticated attempt at a reasonable performance standard. However, as currently drafted, BEPS has not been validly justified, and is fatally flawed in methodology.

If we cannot afford to do it right, we cannot afford to do it at all.

The changes outlined above establish minimum requirements to develop a valid and justifiable standard which would attract the cooperation and support of the building industry.

WILLIAM McCOLLAM, Jr., Pres

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June 26, 1980

Hon. J. Bennett Johnston, Chairman
Subcommittee on Energy Regulation
Senate Committee on Energy and
Natural Resources
Dirksen Senate Office Building
Washington, D.C.

Dear Senator Johnston:

The Edison Electric Institute ("EEI") shares the profound disappointment of your subcommittee that the proposal by the Department of Energy ("DOE") on building energy performance standards ("BEPS") has turned a near consensus on the issue of energy conservation into a fundamental disagreement between the electrical industry and the natural gas industry. We are nevertheless compelled, in the interest of setting the record straight, to reply to certain points raised by the American Gas Association ("AGA") in testimony before your subcommittee on June 5, 1980. Before proceeding to a point-by-point rebuttal of the AGA testimony, a few words need be said about the attitude toward energy conservation in general, and building energy performance standards in particular, held by the Nation's investor-owned electric utilities, who comprise the membership of EEI.

Load management and conservation are already seen in the utility industry as methods to improve plant and equipment utilization and to reduce the need for costly additions to generating capacity. Direct intervention measures, including demand controllers and thermal storage devices, are load management techniques that are being tested for implementation by many companies. Providing assistance to homeowners in the identification, installation, and financing of residential energy conservation measures is a further area in which utilities are actively promoting conservation. This strong utility commitment to conservation extends to energy performance standards for this Nation's buildings as evidenced by our long-standing support of the ASHRAE Standard 90 which has been adopted by more than 40 states. But we cannot support the BEPS proposed by DOE.

EEI believes, fundamentally, that conservation should not mean the promotion of certain energy forms, on the one hand, and disproportionate cutbacks in competing energy forms, on the other. Yet, this appears to be the purpose and the inevitable effect of the weighting factors in the proposed BEPS: the increased use of oil and natural gas, and decreased use of electricity, in all new buildings. It has been estimated that seventy percent of direct energy savings to be achieved by the proposed BEPS would represent direct reductions in the on-site use of electricity, and would provide a bonanza for the natural gas industry. The AGA testimony presented to this subcommittee never squarely addresses this critical point.

Having studiously avoided the issue of the impact of weighting factors, AGA, not unexpectedly, begins its testimony with a discussion of the weighting factor concept. AGA argues that a weighting factor concept, or more precisely, one that measures energy consumed in delivering useful energy to the building line, is necessary to provide a consistent measurement of each form of energy consumed by a building. This assertion is not only untrue, but it contains its own refutation. A site-based standard of energy efficiency is no less consistent among different energy forms than a source-based measurement. The Btu equivalent of any form of energy delivered to a building site is readily determined through a standard engineering conversion factor. AGA's support of source-based standards thus appears to be based not on any conceptual defect in site-based standards, but on the need to balance out the on-site inefficiency of natural gas heating.

Simply stated, if BEPS are to regulate the energy efficiency of new buildings, as Congress intended, they should be based on the energy consumed by new buildings and not the energy consumed beyond the building line. A site-based standard has the strong advantage of providing the designer with a straightforward index of the efficiency of building energy conservation measures, without introducing extraneous variables that are clearly beyond the designer's control.

Just as AGA has misconstrued the concept of weighting factors, so has the association ignored their effect on the individual designer's choice of fuels. In three separate instances, the AGA testimony concludes that BEPS will not dictate a designer's fuel choice, that BEPS will not discourage the use of electricity, and that BEPS will not prevent the use of coal. These judgements do not square with (1) reality; or (2) DOE's own assessment of the effect of weighting factors, but are based, somewhat disingenuously, on the fact that the proposed BEPS do not literally prescribe the use of certain fuels.

Contrary to AGA's conclusions, the use of weighting factors in the proposed BEPS will virtually dictate that a designer choose natural gas or oil for building heating requirements, and categorically avoid the use of electric heating systems. The bias against electricity is firmly embedded in the rule. Faced with a fixed energy consumption budget, the designer must apply a weighting factor to the building's projected consumption of electricity that is roughly three times the weighting factor which is applied to oil and natural gas. If the designer selects electricity for heating, he would be forced, by his budget, to adopt stringent wall, ceiling and window insulation, active solar hot water heating, or some combination of these highly expensive measures. The designer is, however, presented with a less costly, less awkward, and less restrictive set of design options if he chooses a heating system using oil or natural gas. In very real terms, then, the designer is presented with an attractive, if not irresistible incentive to select oil and natural gas as building fuels, but very real obstacles to the selection of electricity. Because the design options are less restrictive if oil or natural gas are selected, buildings using these fuels could be designed to a lower energy conservation standard than a building which used electricity. Such a result was clearly not the intent of Congress.

AGA's claim of designer indifference to these considerations is not only unrealistic, but it ignores the underlying premise of weighting factors. In the preamble to the proposed rule, DOE states that weighting factors "will be important in influencing a designer to save one or another type of fuel when faced with that option during the design process." Moreover, DOE specifically elaborated on what that fuel choice was likely to be: "Thus," the preamble continues, "if a designer must reduce the energy requirements of a building design. . .to achieve compliance with the Standards, he is more likely to reduce gas if site-based weighting factors are used and more likely to reduce electricity if the value-based weighting factors given in the proposed rule are used. . ." Thus, although BEPS are cast in the form of performance standards, the fact remains that weighting factors will exert, within that framework, a powerful influence on the designer's choice of fuels.

The consequence of these individual design decisions will be a shift in nationwide consumption patterns away from electricity and toward natural gas in all new buildings, a market which constitutes approximately one-third of domestic energy demand. This phenomenon will, in turn, have certain important secondary effects which are either discounted or ignored by AGA.

First, while BEPS will certainly not "prevent" the use of coal, the standards will discourage its consumption indirectly by virtue of the bias against electricity inherent in the rule. Based on electric industry figures, coal currently accounts for 48% of all kilowatt-hours of electricity generated, a proportion which can be expected to increase over the next twenty years. Under the mandate of the Powerplant and Industrial Fuel Use Act of 1978, utilities are prohibited from building any new powerplants using oil or natural gas or without the capability to use some other fuel, unless a specific exemption from these requirements is granted by DOE. Legislation recently proposed by President Carter would accelerate the conversion to coal-fired plants. These regulatory developments, in combination with economic trends militating against the continued reliance on oil, will increase the proportion of coal generation to nearly 50 percent in 1985, and about 54 percent in the year 2000. Equally important from the perspective of national energy policy is that the percentage of total electricity generated from oil and natural gas should drop to less than seven percent by the turn of the century. The implication is clear that decreased electricity usage under BEPS means stalling our national policy of conversion to non-depletable and non-critical fuels.

Weighting factors are contrary to this policy because they do not take into account the fuel source used to generate electricity. Electricity produced in the Pacific Northwest from hydroelectric dams or in the Middle West from coal is thus discouraged equally with electricity produced from oil in New England. The only argument that AGA can muster to the contrary is that weighting factors "implicitly account" for energy lost in generation and transmission, and that the average efficiency of electrical generation "has not changed very much" in the past 25 years. While the National Energy Conservation Policy Act provides for a study of second law efficiency, the clear priority of the Fuel Use Act and other legislation is to encourage the development of this Nation's abundant fuel sources for electrical generation. The Administration's National Energy Plan observes in the same vein that the total amounts of energy used in the country will be larger to the extent electricity generated from coal is substituted for oil and gas. Nevertheless, the Plan concludes that "conserving scarce oil and natural gas is more important than saving coal."

Second, BEPS will have a deleterious impact on utility load factors resulting in higher per-unit capacity costs and increased rates. Because most utilities now experience seasonal peaks during the summer, capacity built to meet air conditioning demand will remain idle during the winter. By discouraging electric space heating demand, BEPS will, in effect, cause electric utilities to allocate the costs of this idle capacity to fewer kilowatt-hours of sales, and will necessitate rate increases to cover the higher per-unit costs. AGA's response to this dilemma is to urge increased use of gas air conditioners and gas-fired heat pumps to reduce electricity demand during the summer. To encourage such inefficient techniques as natural gas air conditioning would be a strange result indeed in a program aimed at reducing the energy consumed by buildings. While AGA's recommendation is thus inappropriate, it does reveal a willingness to suggest further conversions to natural gas as the standard solution to almost all problems associated with the BEPS.

Third, according to a major study, a source-energy approach to energy conservation would nearly double gas demand of buildings by 1990, and would more than double the average growth rate for residential and commercial gas deliveries (from 0.6% to 1.6%) during this period. The same study concludes that a source-based standard could provide a potential bonanza for the gas industry. Oddly, AGA's testimony ignores these striking projected increases in natural gas consumption.

The final issue raised by AGA's testimony is whether DOE has statutory authority to promulgate source-based energy performance standards for new buildings. Under settled principles of statutory interpretation, authority, if any, for such standards must be found in the express language or by necessary implication from the express language of ECPA. The issue is not, as AGA would have it, whether "the concept of source-based standards is inconsistent with ECPA." Thus, the extended discussion of independent statutes, their legislative history, and various regulations to elucidate that concept in the AGA testimony is irrelevant. The focus must be on the legislative history and language of ECPA itself.

Since ECPA does not expressly refer to source energy, the express findings and purposes of the statute must be examindd to determine whether Congress intended building energy performance standards to encompass source energy. First, Congress' findings reveal a clear and exclusive concern with the energy consumed in new buildings, and not beyond the building boundary. In section 302(a)(1) of ECPA, Congress found that unnecessary amounts of fuel and energy were consumed in heating, cooling, ventilating and providing hot water for new buildings because those buildings lack adequate energy conservation features. Obviously, the words "consumed in" refer to end-use consumption at the building site. When the reason for the unnecessary consumption is considered, namely, "because such buildings lack adequate energy conservation features", it becomes even clearer that Congress was not concerned with energy consumed beyond the building line. Second, the purposes of ECPA reveal the same concerns. In section 302(b)(1), Congress directed that "reasonable energy conservation features. . .be incorporated into new commercial and residential buildings receiving Federal financial assistance." Finally, Congress' goal of encouraging the adoption and enforcement of BEPS through State and local "building codes and other construction control mechanisms" is consistent only with an intent to reduce the end-use consumption of fuels and energy within the building perimeter.

Any doubt as to the intent of Congress is settled after a brief look at the legislative history of ECPA. In the floor debate in the Senate on H.R.12169, Senator Hollings, a manager for Title III, stated that "conservation is our most important short range energy option. With respect to new buildings, this bill establishes performance standards for new buildings, discouraging building designs which waste energy. This is a critical element of our national energy conservation program." (emphasis supplied). 122 Cong. Rec. S.13556 (daily ed. Aug. 5, 1976). Senator Kennedy, who with Senator Hollings sponsored the June 16, 1976 floor amendments which, inter alia, added Title III to H.R.12169, noted that "(t)he provisions of this legislation offer a comprehensive approach to eliminating waste of energy in heating and cooling homes, apartments, commercial buildings and factories". (emphasis supplied). 122 Cong. Rec. S.13558 (daily ed. Aug. 5, 1976). Here again, energy waste was tied to the efficiency of heating and cooling in buildings rather than the source or movement of energy to a building site.

Further, the report from the Senate Committee on Banking, Housing and Urban Affairs, 94th Cong. 2d Sess., No. 94-623, states that Title III "is designed to reduce energy consumption in new dwellings and commercial buildings in the Nation" (emphasis supplied) (Sen. Rep. at 5), and similarly, the report from the House Committee on Banking, Currency and Housing, 94th Cong. 1st Sess., No. 94-377, states that the objective of Title III was "to introduce construction standards that will reduce significantly the levels of energy consumption occurring as a result of prevailing construction practices" (emphasis supplied). House Rep. at 2. Finally, in the floor debate in the House on H.R.8650, Representative Reuss, a manager for Title III, stated that the intent of Congress was "to encourage the introduction of construction standards that will reduce significantly the levels of energy consumption occurring in those buildings " (emphasis supplied 121 Cong. Rec. H.8412 (daily ed. Sept. 8, 1975). The concern of Congress was thus unmistakable: (1) buildings consume too much energy; (2) that consumption occurs in buildings; and (3) the introduction of construction standards would significantly reduce the amount of energy consumed in new buildings.

Related congressional action in Title II of ECPA -- "Electrical Utilities Rate Design Initiatives -- confirms the clear absence of any authority to promulgate source energy performance standards. There, Congress directly addressed the very problem DOE is now seeking to regulate indirectly, i.e., the generation and transmission of electricity to the building site. In Title II, Congress sought to provide for the development and implementation of: (1) load management techniques which are cost-effective; (2) rates which reflect marginal cost of service, or time of use of service, or both; (3) ratemaking policies which discourage inefficient use of fuel and encourage economical purchases of fuel; and (4) rates (or other regulatory policies) which encourage electric utility system reliability. Having carefully defined the purposes of Title II, it is inconceivable that Congress also intended to implicitly delegate authority to regulate these functions to DOE in Title III.

In conclusion, we observe that one theme dominates the testimony submitted to this subcommittee by AGA: the need for a source energy approach to BEPS is so strong that it overcomes any and all objections, including the very serious concerns raised by EEI. On the contrary, EEI believes that national energy policy, BCPA, and the need for energy conservation in this Nation's new buildings demand that source energy, and weighting factors, be stricken from DOE's proposed rule.

Sincerely yours,

William McCollam, Jr.

William McCollam, Jr.

WM:pgj

GENERAL ELECTRIC

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June 9, 1980

The Honorable J. Bennett Johnston
Chairman, Subcommittee on Energy Regulation
3202 Dirksen Senate Office Building
Washington, DC 20510

Dear Senator Johnston:

The General Electric Company has been following closely the development of Building Energy Performance Standards, and are quite concerned that the rules as presently proposed by DOE are contrary to National Energy Policy and not consistent with the intent of the enabling legislation passed by Congress.

We are pleased that you held oversight hearings on this subject on June 5, 1980, and appreciate the opportunity to submit the attached statement for the record, and consideration by the members of your subcommittee. We would be happy to discuss our statement with the members or staff at anytime.

Sincerely,

Warren W. Walkley

Warren W. Walkley, Manager
Technical Analysis

WWW:bfn

Att.

GENERAL ELECTRIC COMPANY STATEMENT
TO
ENERGY REGULATION SUBCOMMITTEE
OF THE
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
ON
BUILDING ENERGY PERFORMANCE STANDARDS

The General Electric Company presented oral testimony, and submitted written statements at public hearings held in Atlanta, Georgia, Los Angeles, California and Washington, D.C. on the NOPR for Energy Performance Standards for New Buildings. The extent of our participation in these hearings reflects our deep concern that the presently proposed rules:

1. are contrary to National Energy Policy,
2. will result in construction of buildings that do not reach attainable levels of energy efficiency,
3. will prescribe standards that are unnecessarily costly to the consumer and unduly burdensome to the building industry, and
4. are not consistent with the legislative intent of the Energy Conservation and Production Act of 1976.

The General Electric Company strongly favors energy conservation consistent with national goals of maintaining a healthy economy, and achieving a rapid and orderly transition from an oil dependent economy to one based on diversified and more abundant and secure energy sources. Thus we endorse and support performance standards as specified by the enabling legislation of ECPA, as we believe such standards allow design flexibility and encourage innovation in building design and the use of renewable energy sources. We strongly oppose the proposed rules issued by DOE which obfuscate the clear intent of ECPA to increase the energy efficiency in and of buildings, and offers a fuels selection criteria program instead of the building energy conservation program intended by Congress.

Fuels selection and usage, and the efficiency of electrical generation and transmission are addressed in other legislation intended to deal specifically with these subjects. Congress found in Title II of ECPA that improvement in electric utility rate design has great potential for encouraging energy conservation. The Public Utility Regulatory Policies Act of 1978 (PURPA) included additional provisions regarding utility ratemaking standards, and mandated other programs to increase conservation of electric energy and to make the most efficient use of electric utility facilities and resources. Finally, the Powerplant and Industrial Fuel Use Act of 1978 (PIFUA) severely limits the amount of oil or natural gas that can be used for the generation of electric energy. Thus, these laws should provide the basis for programs that improve efficiency of electrical utility systems, promote conservation in the use of electric energy, and determine the fuels to be used in electric generating stations. It is not the purpose of BEPS to take on these functions through the regulatory process, and thus usurp the powers of Congress.

The proposed standards create a preference for increased use of oil and natural gas - results in direct contradiction to the need to preserve scarce fuels, and in direct contradiction to national energy policy as enumerated by the President, the Secretary of DOE, and by Congress to reduce our reliance on imported oil. Such results are created by DOE's use of weighting factors which discriminate against the use of electricity, and do not recognize the sources of energy utilized in its production, nor the inherent flexibility of large utility systems to respond to changes in the availability and costs of the fuels which are used. The use of weighting factors, or any other source energy criteria emphasizes fuel selection or usage, a result totally unrelated to energy efficiency in new buildings, which leads to our second major concern with the proposed rules.

DOE has not proposed uniform efficiency standards, but two sets of standards: a stringent standard for buildings using electricity, and a relaxed standard for buildings using oil or natural gas. Such a double standard promotes the construction of buildings using natural gas or oil for heating because these homes can escape with lower levels of insulation, and are less costly to construct. They are also substantially less energy efficient, and let the building designer avoid the need to use modern conservation techniques and designs.

We feel that changes as indicated above are needed in the DOE proposed rules to make the standards workable, equitable, effective, and consistent with Congressional intent. We also feel that issuance of final building energy standards should be delayed until the implementation standards have been issued, and comments on those standards received and considered. We therefore endorse and encourage the support of the Subcommittee for a two-year extension provision for building energy performance standards as proposed in Section 316 of S.2719 (Housing and Community Development Act of 1980). Such an extension would provide DOE with ample opportunity to redress the serious flaws now contained in their proposed rules on BEPS.

SUPPLEMENT STATEMENT
OF
THE INDUSTRY COUNCIL ON ENERGY PERFORMANCE STANDARDS
ON LIFE-CYCLE COSTING

SUBMITTED TO THE
SUBCOMMITTEE ON ENERGY REGULATION
OF THE
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
ON THE
DEPARTMENT OF ENERGY'S
PROPOSED BUILDING ENERGY PERFORMANCE STANDARDS

SUPPLEMENTAL STATEMENT OF INDUSTRY COUNCIL ON ENERGY PERFORMANCE STANDARDS ON LIFE-CYCLE COSTING

The Industry Council on Energy Performance Standards ("ICEPS") is an umbrella organization comprised of the Nation's pre-eminent electrical industry trade associations. The members of ICEPS are: the American Public Power Association, the Association of Home Appliance Manufacturers, the Edison Electric Institute, the International Brotherhood of Electrical Workers, the National Association of Electrical Distributors, the National Electrical Contractors Association, the National Electrical Manufacturers Association, and the National Rural Electric Cooperative Association. ICEPS is submitting this supplemental statement to present its views on a vital aspect of the proposed building energy performance standards ("BEPS"): The Department of Energy's ("DOE") use of life-cycle cost methodology to set performance standards for all new single-family residential buildings. ICEPS also presented testimony before this subcommittee on June 24, 1980.

The theory behind life-cycle costing is simply developed. Based on the economics of investing in energy-saving equipment, life-cycle costing balances the cost of additional conservation measures against reduced energy costs. The methodology is well-suited to the individual homeowner who wishes to make an investment in an energy efficient home. If the cost of conservation equipment, such as R-25 wall insulation, is less than the discounted value of energy savings to be realized over its useful life, then the investment is justified. The analysis is completely dependent on forecasts of future energy costs, because it is only on this basis that the expected dollar value of energy savings can be measured.

While life-cycle costing can often be a valuable tool for the individual homeowner, ICEPS believes that it is totally inappropriate as the means to identify the "minimum life-cycle cost" to all consumers and energy budget levels for all single-family residences. That is precisely what was undertaken by DOE in the proposed BEPS -- the identification of an "optimal" level of investment in energy conservation equipment, reflected in minimum energy budgets for every homeowner, in every new single-family home, in 78 regions across the country.

ICEPS further submits that DOE's life-cycle cost analysis has resulted in inequitable budget levels, and has transformed BEPS from an energy conservation program into one whose entire focus is the economics of fuel choice. The result is a "standard" that (1) establishes three separate budget levels, depending on the fuel type chosen, and (2) severely discriminates against electricity. As shown below, that discrimination is totally unrelated to practical considerations of building efficiency. It is based instead on DOE's uncertain conclusion that saving electricity will give homeowners the greatest payback in saved energy costs.

DOE's determination of projected energy savings, and the energy budget levels themselves, are primarily based on projections of the future prices of oil, natural gas, and electricity. Yet, experience has demonstrated that future energy prices cannot be predicted to any reasonable degree of reliability. For example, in April 1979, DOE projected that the price of home heating oil would be $25.60 per barrel in 1980. In January of 1980, events dictated that DOE revise its forecast to $37.80, an increase of 48% in just nine months. In life-cycle cost analysis, dollars of energy saved must be estimated over an extended period of time (the payback period). To meet this problem, DOE assumed a constant price escalation rate for each energy source.

The entire rationale for the proposed BEPS for single-family residences is predicated on the accuracy of these assumptions. If actual experience proves that the escalation factors are at all inaccurate, the energy budgets for homeowners will not yield an optimal level of investment in conservation equipment, as claimed by DOE, but some arbitrary level of investment. Whether that level corresponds with the "maximum practicable improvement in energy efficiency" mandated by Congress in the Energy Conservation and Production Act ("ECPA")(section 302(b)(2)) is as uncertain as the price projections themselves. Moreover, any deviation from the "optimal" level of investment will be magnified enormously due to the fact that energy conservation features to be built into new construction will last for thirty years. In practical terms, this means that BEPS will encourage design judgments that may be obsolete almost as soon as they are made.

DOE's life-cycle costing methodology is also directly responsible for the clearcut discrimination in the proposed BEPS against electricity and in favor of oil and natural gas for single-family homes. Because the calculations of energy savings were done separately for each fuel, life-cycle costing generated three different energy efficiency standards. The annual energy budget (derived from life-cycle costing) for heating and cooling a single-family detached home in Louisville, Kentucky, for example, is 32.9 Mbtu's per square foot if the designer chooses natural gas for heating, 31.23 if oil is chosen, and only 12.62 -- less than half the budget levels for natural gas or oil -- if the designer chooses an electric heating system. Under DOE's life-cycle cost analysis, the higher projected price for electricity corresponds to a higher investment in energy conservation measures for homes with electric heat pumps and electric resistance heating. The higher level of investment in conservation measures means, in turn, that electrically-heated homes will have to meet more stringent energy budgets than gas- or oil-heated homes.

In short, based on DOE's assumption that projected prices of electricity will be substantially higher than oil or natural gas prices -- an assumption that is inherently unreliable -- the agency has proposed two different standards -- a stringent standard for buildings using electricity and a lenient standard for buildings using oil or natural gas. The wide disparity between these standards is illustrated in the

Notice of Proposed Rulemaking. In almost all of DOE's examples, gas-heated homes can meet the budget levels with less stringent insulation levels, less window glazing, and less efficient hot water heating technology than buildings using electric heating. It is difficult to understand how DOE can possibly justify the use of life-cycle costing when that methodology results in lower levels of insulation, and greater energy waste, for buildings using this Nation's scarcest fuels.

These shortcomings of life-cycle cost analysis, and the discriminatory scheme that results from its use, call into question DOE's decision to base the standards for single family residences on the economics of fuel choice, rather than on practical considerations of building efficiency. While economic considerations should be incorporated into a test of what is practicable, it is neither necessary nor advisable to make economics the exclusive test.

The scheme of ECPA militates against DOE's choice of life-cycle costing analysis to define the level of building efficiency standards. Nowhere in ECPA did Congress mandate a building standard based solely on economics. In fact, it appears that Congress' intent was that DOE set performance standards at a reasonable level of energy efficiency -- that is, a level sufficient to ensure the incorporation of practicable insulation and other conservation techniques in new construction. As provided in section 310 of ECPA, DOE was then to test the economic costs and benefits of such standards. In attempting to set budget levels at the minimum life-cycle cost point, DOE has placed an extreme emphasis on economics, and has distorted Congress' directive to promote "maximum practicable" improvements in energy efficiency. Moreover, as shown above, DOE's economic approach will not maximize energy efficiency as Congress directed, but will allow the creation of an entire class of inefficient buildings, based solely on the designer's choice of fuels.

The proposed standards would be greatly simplified if DOE set uniform performance standards at a reasonable level. This level should be defined, not by life-cycle costing, but by measuring the energy consumption characteristics of buildings using practicable wall, ceiling, and window insulation techniques. ICEPS believes that this is a sounder approach because it focuses BEPS on the correct target: setting the level of energy conservation in an energy-efficient building. Once that level is determined, DOE should analyze the standards in terms of economic cost and benefit as well as other factors enumerated in the statute. This is a straightforward, equitable approach -- an approach which is totally consistent with the congressional mandate to achieve maximum practicable improvements in energy efficiency.

Apart from its simplicity, this approach to BEPS would have several additional advantages. First, it would focus on the building structure, which is relatively permanent, rather than on the fuel system -- or relative fuel prices -- which may change a number of times over the life of a building. Second, it would leave the choice of fuels, and the economics of that decision, to consumers and the marketplace. For consumers, an economic incentive would still exist for achieving the maximum level of energy conservation at the lowest cost. Uniform standards would simply assure that buildings would incorporate some acceptable combination of energy conservation measures. And third, it would be equitable to existing suppliers of energy and fuels.

In closing, ICEPS submits that both life-cycle costing and weighting factors have been used by DOE to create a discriminatory building energy performance scheme. ICEPS has contended, in testimony previously submitted to this subcommittee, that weighting factors should be stricken from the BEPS to eliminate that discrimination. For the reasons cited above, ICEPS believes that DOE's life-cycle costing approach is also responsible for that discrimination, and should be eliminated before the promulgation of the final rule.

STATEMENT
OF THE
MECHANICAL CONTRACTORS ASSOCIATION OF AMERICA
BEFORE HEARINGS OF THE
U S SENATE SUBCOMMITTEE ON ENERGY REGULATION
ON
BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

5 June 1980

Mr. Chairman and Members of the Subcommittee:

The Mechanical Contractors Association of America, known by its initials MCAA, appreciates this opporunity to present our statement related to the proposed Building Energy Performance Standards (BEPS).

MCAA is a construction trade association of about 1500 firms, employing approximately 125,000 persons. Almost all of the firms employ union labor. A mechanical contractor builds systems that move fluids, both liquid and gas. This includes the fabrication and installation of heating, ventilating, air conditioning and process piping systems, and further encompasses service, maintenance and the testing, adjusting and balancing of these systems. Our work affects multi-residential, commercial, public and industrial facilities. The equipment our members install is the principal user of energy in buildings, and energy is the key to our industry. Consequently, conservation and effective use of our nation's fuel resources are and have been concerns of MCAA. We have extensive experience and know-how in this field. Even before the OPEC oil embargo in 1973, MCAA had formed an Energy Conservation Committee to inform and assist our members in the areas of energy conservation.

MCAA is a member of the American National Standards Institute (ANSI) and other standards-writing organizations. We are represented on a number of committees concerned with development of standards relating to energy.

MCAA, through its Energy Committee, has studied the Building Energy Performance Standards (BEPS) and offers the following comments:

An excellent standard for energy conservation for new buildings has been in existance since 1975 and has been placed in effect totally or in part by 44 states. This standard, American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 90 (formerly ASHRAE Standard 90-75) "Energy Conservation in New Building Design" was developed at the direct request of the Federal government and with the strong urging of the National Conference of States on Building Codes and Standards (NCS/BCS). Its widespread acceptance and use is evidence that it is practical and workable.

The extensive work that produced ASHRAE Standard 90 should not be invalidated. To require BEPS as a standard to override and replace Standard 90 will undo several years of work by the various states, and will be counterproductive in implementing energy conservation throughout the nation. It should remain in effect rather than being replaced. ASHRAE Standard 90 should be retained as an acceptable means for compliance with BEPS.

With regard to BEPS itself, it appears that the statistical base and research related to the standard was not complete when the proposed standard was published. The requirements for computer analysis of building design may be difficult for smaller firms to comply with, and will increase design costs. Sufficient time should be allowed for completion, examination, evaluation and field testing of the data base and requirements of BEPS before the standard is placed into effect. An earlier suggestion by Senator Jackson in an Engineering News Record article (March 6, 1980) that BEPS be activated on a trial basis in several states is a reasonable and realistic proposal.

In view of the valid reservations concerning the data base and other requirements of BEPS, a timetable for implementation of these standards by August 1981 appears too ambitious. Accordingly a delay in promulgation of BEPS is appropriate in order that the existing problems can be resolved effectively.

In summary, MCAA recommends that:

1. BEPS not be implemented to override ASHRAE Standard 90, but that both standards be promulgated in a way that retains Standard 90 as an acceptable alternative to BEPS.

2. The data base and requirements of BEPS be validated further by completion of research and by trial on a limited basis before the standard is implemented nationwide.

3. Efforts of the Federal government and industry be directed toward resolution of valid concerns concerning BEPS in order that the standards, when implemented, be accepted on a consensus basis rather than solely by government mandate.

4. A realistic time schedule be set by the Congress for implementation of the BEPS program.

Representatives of MCAA will be pleased to discuss this matter further with you and/or members of your staff at your convenience.

COMMENTS BY

JOHN R. STEVENS
VICE PRESIDENT, BOSTON EDISON COMPANY

ON

PROPOSED RULES TO IMPLEMENT TITLE III OF THE ENERGY CONSERVATION AND PRODUCTION ACT

PREPARED FOR

SUBCOMMITTEE ON ENERGY REGULATION
OF THE
SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

JUNE 10, 1980

Mr. Chairman, members of the Subcommittee on Energy and Environment, we appreciate the opportunity to submit these comments on "Proposed Building Energy Performance Standards" on behalf of Boston Edison Company. The Company supports a program for energy efficiency standards for new structures, but is concerned that the weighting factors proposed by BEPS would essentially exclude the use of electric energy for both space conditioning and water heating purposes. This would eliminate an option that could save consumers money in the installation and operation of heating and cooling systems while at the same time reducing the nation's dependence on imported oil and natural gas. In presenting our views, I would like to first review some recent Congressional actions before providing general and specific comments which concern our Company and impact our consumers.

In November 1978, Congress, in its wisdom, enacted Public Law 95-619, the National Energy Conservation Policy Act, a part of the National Energy Act. In the opening paragraphs of the NECPA, there are these significant statements: "The Congress finds that...the United States faces an energy shortage arising from increasing demand for energy, particularly for oil and natural gas, and insufficient domestic supplies of oil and natural gas to satisfy that demand." And further, "All sectors of our nation's economy must begin immediately to significantly reduce the demand for nonrenewable energy resources such as oil and natural gas..."

In August 1976, Congress, in its wisdom, enacted Public Law 94-385, the Energy Conservation and Production Act (ECPA) authorizing the Department of Energy to promulgate building energy performance standards (BEPS). With this Act, Congress issued a mandate to DOE to eliminate the waste and unnecessary consumption of energy in new buildings. The intent was to require the Department to issue regulations to encourage and require building designs which make the most efficient use of energy for heating, cooling, ventilation and for hot water requirements. On November 28, 1979, the Notice of Proposed Rulemaking appeared in the Federal Register.

One of the highlights and primary concerns with the proposed regulations is the inclusion of weighting factors applied to the energy budgets which we feel are biased against the use of this country's natural resources and the capabilities of the electric utility industry. The weighting factors according to DOE account for the difference in cost among energy types and the relative national value in conserving certain fuels. They are based on the projected 1985 price of natural gas, oil and electricity, and adjusted by adding a premium to oil and natural gas to reflect the added value of saving those fuels. More specifically, the factors are based on the relative value of different fuels to the nation expressed in terms of (1) energy prices, and (2) "explicit national policy determinations of non-market values associated with specific fuel types". Weighting factors of 2.79 for electricity, 1.22 for oil, and 1.0 for natural gas have been computed by DOE for use in preparing the comparative heating budgets for new residential structures.

These factors replace the earlier controversial Resource Utilization Factors (RUFs) and Resource Impact Factors (RIFs).

They are supposedly different and derived from a new data base. However, the new weighting factors except for some minor changes in the second decimal place are exactly the same as those used for the RUFs and RIFs, which DOE rejected as "unworkable".

The use of weighting factors is nothing more than an attempt to specify a national fuel selection procedure that dictates the increased use of imported oil and natural gas and discourages the use of electricity. These factors have no support in the ECPA or its legislative history, or in the national policies of this country. In fact, they are contrary to national energy policy.

The fundamental fallacy is classifying of electricity as a "fuel". Coal, uranium and hydro power are used to generate electricity; and it is impractical for uranium or water, and to a certain extent coal, to be used for heating buildings in any way other than through the production of electricity. DOE ignores the value of using these fuels for the generation of power as a means of attaining energy independence.

The fallacy of treating electricity as a fuel is nowhere more obvious than in DOE's use of national average prices as a basis for developing the relative weights among gas, oil, and electricity. While oil may have a relatively uniform price nationwide, electricity prices vary substantially among different regions. The price of electric power varies, among other things, depending on the costs to the individual electric utility of the fuels used for generation; the nature of its generating capacity, including the proportion of base, intermediate, and peaking capacity; its transmission configuration; its daily load shape, including the proportion of its peak and base load demand; its capital costs;

the season; the time of day, where time-of-day pricing has been instituted; and the class of customer, including the nature of metering to the customer. As a result, the use of national average electric costs by DOE produces a weight for electricity that bears no relation to its actual cost in a particular area of the country. Nevertheless, the design of every new building will be based on those fictional values if DOE's proposal becomes final. This discussion suggests the degree of complexity involved in accurately accounting for electricity prices. In developing its ration of "fuel" prices normalized on the basis of the weight for natural gas, DOE has obviously compared an orange with two kinds of apples. Such decision-making is not only unfair, but analytically unsound.

Another basic fallacy in the assumptions underlying the weighting factors relates to DOE's use of a premium in the weighting of oil and natural gas. This raises a major question about the internal inconsistency of the weighting factors. The premium was intended to place a higher weight on oil and natural gas thereby discouraging their use; yet, the relative weights after the premium is added actually discourage the use of electricity regardless of source. In adding a premium to the weights for oil and gas, DOE implicitly acknowledges the need to reduce or eliminate oil and gas use while adopting weighting factors that largely compel their consumption. In so doing, DOE defies the national energy policy directives established by Congress and the President, yet another illustration of the false policy assumptions upon which DOE's approach is based.

Still another fallacy in the assumptions underlying the weighting factors stems from the flawed policy perceptions DOE brings to the BEPS program. While DOE contends that the high cost assigned to electricity is evidence of its greater "value" to the nation, in fact value in this context is a euphemism for the opposite. DOE obviously considers the greater use of oil and gas beneficial to the nation because of the size of the weights assigned to those fuels relative to electricity. That being the case, there are a number of benefits from the consumption of electricity as well as recently developed uses of electricity that DOE has ignored in developing its reverse-value equation.

One benefit of the consumption of electricity that DOE has ignored involves greater control over environmental pollution. In discouraging the use of electricity for space heating, DOE will be encouraging on-site generation of heat in many parts of the country. While electric utilities are required to conform to the emissions standards of the Environmental Protection Agency ("EPA"), the on-site use of oil, gas, wood, or coal or on-site diesel cogeneration for space heating produces ground-level emissions that may exceed EPA standards and cannot be effectively controlled. DOE's weighting factors also ignore characteristics of electricity that encourage energy conservation. Electric resistance heating is more easily subjected to thermostatic zone control that is oil or gas. It has been estimated that a 37-percent savings in energy can result from improved in-space temperature control. DOE has not presently incorporated individual room controllability in its calculations of the weighting factors. Finally, in recent years, the design of electric heat pumps has undergone revolutionary changes that greatly increase energy savings from their use. In fact, alone among energy heating systems heat pumps can deliver at the building boundary more Btu's of energy than heat pumps consume. Nevertheless, if the proposed standards are adopted containing the weighting factors and effectively requiring the kinds of insulation with electric heat pump use that is too costly and too difficult for a designer or builder to install, the use of electric heat pumps will greatly decrease.

This discussion of the weighting factors proposed by DOE indicates that (1) Congress intended for BEPS to be a construction conservation program and not a fuels management program; (2) there is no justification for the fuel weights proposed by DOE in fact or logic; and (3) the DOE proposal will result in increased consumption of oil and gas in contravention of national energy goals. The criticisms of the assumptions underlying the weighting factors suggest that DOE has made cosmic decisions on what is good and not good for the nation on the basis of incorrect policy assumptions that are internally inconsistent and factually inaccurate. For these reasons, DOE should not include fuel weights of any kind in the energy budget levels implemented by the final rule.

With respect to Boston Edison, the BEPS weighting factors have special significance. The generation mix supplied to our customers during the year 1979 was approximately two-third residual oil fired and one-third nuclear. Our generation expansion plans call for the construction of an additional nuclear unit (Pilgrim 2) to commence within a year pending approval of the construction permit by the NRC. This will raise the nuclear component to almost 50 percent. In addition, studies are underway to convert our Mystic 4, 5 and 6 units to coal if technically, environmentally, and economically feasible. These units are presently listed by the Department of Energy as potentially coal convertible, since they were fired by coal prior to their conversion to oil approximately 15 years ago. Studies are also being conducted on the construction of a new coal-fired generating unit at our Edgar Station site in Weymouth, Massachusetts. This unit would replace oil-fired generation recently retired at this location. In summary, therefore, we are moving towards a greater reliance on nuclear and coal generation to replace residual oil both for economic reasons, security of supply, and to be consistent with national policy.

This background information is supplied simply to show that electric space heating on Boston Edison's sytem is supplied at least in part from other than oil-fired sources. Considerations of this nature are absent from DOE's proposed weighting factors. They in fact would likely promote the burning of additional amounts of oil and gas and exclude electric space conditioning contrary to national energy policy. In addition, when we examine the load characteristics of electric space heating, we find that a large share of that load is off peak, i.e. supplied during evening and weekend hours. During these time periods, the major share of electric generation in Boston Edison's case comes from nuclear-powered sources. Further, as described earlier, an even greater share of Edison's off-peak requirements will be supplied in the future via base load nuclear or coal-fired sources.

The selection of the basic heating source, for most facilities, especially in northerly climates such as New England, generally determines the energy source used for water heating and in some cases, air conditioning. Therefore, the space heating decision is especially important to utilities such as Boston Edison since water heating can also be supplied as off-peak service from nuclear and coal-fired sources.

The need to preserve the electric option becomes even more pronounced when we consider new innovations in heating and cooling which depend upon electric energy. In the case of the heat pump, which supplies more heat than the energy consumed, energy savings can be realized over oil or gas alternatives. Other innovative systems such as thermal off-peak storage, which allows energy to be stored during evening hours and released as needed, also provides a unique way to supply space conditioning and water heating using off-peak generation.

A specific benefit to electric consumers in preserving these space and water heating options is that they can elect the best system to serve their particular needs on a competitive basis. Without these options, the consumer would be restricted to the use of oil or gas, as well as the conventional systems presently utilized for the supply of heating and cooling requirements. In other words, without electric space and water heating options, the oil and gas industries would have a virtual monopoly on this market.

The benefit to the utility and to the consumer is that increased off-peak electrical usage through the use of electric space and water heating systems helps to offset the heavy fixed

best copy available

costs associated with base load capacity through load factor improvement. This results in lower costs to all consumers. Further, these applications make better use of transmission, distribution and other electric service facilities designed to provide for peak loads. Both of these considerations are particularly pertinent in the case of Boston Edison which is a summer peaking company.

It is for these reasons that Boston Edison and the electric utility industry take exception to the proposed BEPS weighting factors. We, as well as our industry, stand willing to assist DOE in developing logically derived energy usage factors which are technically accurate and in accord with national energy policy. Anything less would be inconsistent with Congressional intent and be a disservice to the consumers and shareholders whom we represent.

International Brotherhood
of Electrical Workers

Charles H. Pillard
International
President

Ralph A. Leigon
International
Secretary

IBEW

1125 15th St. N.W.
Washington, D.C.
20005

June 4, 1980

Honorable J. Bennett Johnston, Chairman
Energy Regulation Subcommittee
Committee on Energy and Natural Resources
United States Senate - Room 3202
Dirksen Senate Office Building
Washington, D. C. 20510

Dear Senator Johnston:

Enclosed you will find 35 copies of my statement on behalf of the International Brotherhood of Electrical Workers, AFL-CIO, to members of the Energy Regulatory Subcommittee that is holding hearings on June 5, 1980 relative to the Department of Energy's implementation of the Building Energy Performance Standards Program. If you should have any questions or desire additional copies of this statement, please let me know.

Very truly yours,

Charles H. Pillard
Charles H. Pillard
International President

CHP:es
Attachment
cc: Hon. Howard M. Metzenbaum, Vice Chairman
    Hon. Henry Bellmon
    Hon. Bill Bradley
    Hon. Dale Bumpers
    Hon. Pete V. Domenici
    Hon. John A. Durkin
    Hon. Wendell H. Ford
    Hon. Mark O. Hatfield
    Hon. James A. McClure

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS
1125 - 15TH STREET, N.W.
WASHINGTON, D. C. 20005

COMMENTS OF
INTERNATIONAL PRESIDENT CHARLES H. PILLARD
ON

BUILDING ENERGY PERFORMANCE STANDARDS
PROPOSED BY
U. S. DEPARTMENT OF ENERGY

AS SUBMITTED TO
THE HONORABLE J. BENNETT JOHNSTON, JR., CHAIRMAN,
ENERGY REGULATION SUBCOMMITTEE
UNITED STATES SENATE
ENERGY AND NATURAL RESOURCES COMMITTEE

JUNE 5, 1980

Statement of Charles H. Pillard, International President of the International Brotherhood of Electrical Workers, AFL-CIO, before the Subcommittee on Energy Regulation, Energy and Natural Resources Committee, United States Senate, on Building Energy Performance Standards proposed by the U. S. Department of Energy.

By way of introduction the International Brotherhood of Electrical Workers (IBEW) is the nation's largest electrical workers' union and represents a membership of approximately one million employed in all phases of the electrical industry, including a substantial number in the construction, manufacturing, and gas and electric utility industries.

In behalf of our membership and albeit somewhat presumptuous, our nation's interest, we offer comments on the Department of Energy's proposed rules on Building Energy Performance Standards for consideration by the Subcommittee.

Our desire to be heard in this matter can be expressed in terms as equal to the growing sense of national frustration with Federal regulators who ignore the representative systems of government by reaching far beyond specific authorities granted them by the Congress.

In this regard the IBEW is mindful of the mandate of Congress to the Department of Energy when in 1976 Congress granted authority to the DOE to develop rules for Building Energy Performance Standards under the Energy Conservation Standards for New Buildings Act of 1976, which was enacted as Title III of the Energy Conservation and Production Act and also the Department of Energy Organization Act.

There is no question as to the wisdom of Congress in recognizing and establishing in law the base mechanics and authority to promulgate and implement energy conservation measures in building design. As building tradesmen and workers in the energy industry, as well as consumers, we of the IBEW have been cognizant of the costs and problems created by inefficient building designs. Not always has this been the fault of designers and builders. In our view it has been apparent that the building industry has found innovation in energy conservation design restricted due to fragmented local building specifications. In addition, the industry has understandably experienced a real sensitivity to escalating first costs of construction, which have been over balanced with relation to a building's operating costs; a manifestation, we believe, of cheap energy habits of the past.

We consider it reasonable that Congress act in the national interest and provide the impetus to achieve conservation of energy in building standards

However, the IBEW stands in opposition to the adoption of rules or regulations which are counterproductive, in lack of genuine reason or which would serve to stymie motivation for energy related technology innovation needed for the critical decade of the 1980's. Indeed, many have expressed concern that the national survival will, in the long run, rely on our ability to produce technological improvements and innovations in energy systems and supply. We recognize the reaility that the most stringent conservation measures will not produce one BTU or milliwatt.

Our immediate concern is that if we are to reverse the perceived trend in declining national productivity and workers' standard of living, rival technologies in energy forms and fuels should be encouraged to fully compete in the marketplace and simultaneously seek the highest level of efficiency. The development and exploitation of innovation, efficiency, and conservation, coupled with the realities of availability of finite resources, are factors to be equally considered in America's immediate and future energy prospectus.

The IBEW respectfully submits that the Department of Energy's Building Energy Performance Standards fall short of these considerations, oversteps the authority assigned by Congress, and are arbitrarily discriminatory with respect to the electrical industry as producers and suppliers of a form of energy, equipment, service, and technology.

Specifically, we address our comments to the Department of Energy rule which deals with so-called weighting factors.

As we understand the standards, Energy Budget Levels stated in thousands of British Thermal Units per square foot of gross area of building design per year are established for 78 different Standard Metropolitan Statistical Areas for various classifications of buildings and residences.

The Standards also provide a method for applying the Energy Budget Levels to a building design of a specific type in order to obtain an annual rate of energy consumption which is the Design Energy Budget.

Further, a method is supplied which is to be used in estimating the amount of energy which a specific building or unit will consume annually. This is the Design Energy Consumption.

If the Design Energy Consumption exceeds the Design Energy Budget for a particular building design, the design is inadequate and out of compliance with the standards.

Our concern is with the method of that determination.

In order to determine compliance with the standards, a building designer must balance the Design Energy Budget with the Design Energy Consumption using the methods of calculation provided in the standard. However, that balance is predicated on weighting factors arbitrarily applied to energy sources.

The IBEW submits that the application of the standard's weighting factors do not serve the intent or purpose of Congress as set forth in the enabling legislation, and in fact, is an aberration which introduces a national energy program rather than an energy conservation program as intended.

If the standards are adopted in present form, we can expect to see a significant increase in oil and natural gas demand and consumption for use in buildings at a time when we find it imperative to wean ourselves away from the petro habit.

The weighting factors (set as BTU multipliers of 1 for natural gas, 1.22 for oil, and for electricity, 2.79 for single family residential buildings, and (separately) for Commercial and Multifamily residential buildings as 1 for natural gas, 1.20 for oil, and 3.08 for electricity)[1] will have a profound impact on our future energy supply as well as an immediate negative impact on the electrical industry and its workers.

By application of the weighting factors, building designers are compelled to favor the use of oil and natural gas over electricity regardless of the availability of supply or comparative energy efficiencies in competing systems or systems' mix. It is beyond our comprehension that Congress would permit such a regulatory anomaly in the energy industry when our recent history dictates that America's energy independence is reliant on more flexibility in choice of energy supply.

Maximum conservation of all energy forms is the optimum we must pursue; but in terms of reality, conservation itself carries a cost in material, manpower, and technology that is not readily apparent. We remain mindful of the insulation material shortage following the 1973-1974 oil embargo and the resultant jump in material costs. We are also concerned with the alleged flame/toxicity combination hazard found with the foam type insulation used in hundreds of thousands of homes. Crash attempts at energy conservation while well meaning have not always produced the desired results and in many cases have been less than cost effective. Again, conservation if carried out to the maximum will not produce one BTU, horsepower, or candlepower.

Conservation costs will, however, buy the necessary time to develop renewable energy sources and put in place energy systems and retrofits which utilize our abundant domestic resources. As has been said before, "we do not have an energy shortage, we have a petroleum shortage."

The renewable resources we will rely on to fuel our future growth and development into the next century will be delivered in the form of electricity. The thought that at this time the government would mandate even greater utilization of both foreign and domestic non-renewable natural gas and oil by regulatory methods is to us incomprehensible if not irresponsible.

The electric utility industry is already overburdened with the direct cost of complying with a myriad of regulations; a cost which is eventually borne by the consumer and which has contributed to the financial ill-health of an industry which from Thomas Edison to now has provided the most substantial contribution to the nation's industrial and economic might.

	Natural Gas	Oil	Electricity
[1] Single Family Residential	1	1.22	2.79
Commercial & Multifamily Residential	1	1.20	3.08

The IBEW membership represents in itself a large association of consumers. Considering the variables in available fuel mix among geographic regions in America, we find it essential that consumers retain the freedom to choose energy systems which are both available and affordable for specific situations in particular areas. For example, the Northeast United States has little natural gas and relies largely on oil for home heating. Many suburban areas throughout the country have no natural gas supply lines. We find it impractical to believe that coal, wood or even solar are practical or desirable for consumers in many of these areas when efficiency is scaled with costs.

The costs of regulation in the electric utility industry, while we do not at this time discuss the reasonableness of other regulations, is a major factor in increased consumer energy costs. The increased cost of product alone has had a substantial effect on conservation of electrical energy. On the other side of the coin, the cost of generating and distributing the power has created an unparalleled development in efficient production, transmission, distribution, and use of electricity. While regulatory delays, increased costs of capital funding, and endless intervenors acting in the name of the public good have created or contributed to some serious local supply situations, we believe the common good will eventually prevail to assure adequate generation of safe, clean electrical energy.

We understand that the Electric Power Research Institute, the research and development arm of the electric utility industry, has this year budgeted a record $250 million in research and development projects aimed at improving the economics of the industry and its product. Separately, manufacturers of electrical equipment and electrical consumer products have on the market or in stages of development products of new generations of technology which exemplify more efficient use of electric energy. Notable among these are products for heating and cooling buildings with area controls that are capable of storing, retrieving, and delivering thermal energy in desired amounts to specific areas. This same concept is used by some electric utilities to store off-peak power.

Electricity which will be produced by new technologies such as fusion, solar photovoltaics, fuel cells, magnetothermodynamics and tidal sources, and a better utilization of existing technologies such as low head hydro, cogeneration, and most importantly safe nuclear and coal-fueled generation, offer us a survivorship and real energy future. This is available in part now and in part if we choose to fully develop our options. We do have a choice at a time of the deepest national concern regarding our shameful dependence on foreign energy. Our present situation as a nation relying on foreign energy purchased at the price of extortion in an unstable international political climate should be reason enough to remind us of our past follies and prompt the encouragement of a demand side market for energy supply and technology other than that which depends on oil and gas.

Non-renewable natural gas and petroleum resources are vital for certain industrial and agricultural processes and products. We suggest that the cumulative effects of the Department of Energy standards which promote the use of oil and gas for space and hot water heating will in time contribute to premature shortages and price rises to products in these areas.

As mentioned before electricity is not dependent on any one source of fuel. It is an energy form rather than a fuel source as misdefined in the Building Energy Performance Standards. As such, central generation electrical energy offers a flexibility impossible to obtain with natural gas and oil, is compatible with either, and for the foreseeable future will compliment most solar energy systems.

The International Brotherhood of Electrical Workers, of course, speaks out for the welfare of its members. In doing so sometimes we find common ground with employers. The electrical industry and its workers share a community of interest on the issue of the Building Energy Performance Standards weighting factors. Growth and development of the electrical industry within the confines of consumer demand is an eventuality which if further forestalled by artificial factors and bias may prove to be the most costly legacy of the 80's for the workers and consumers of our nation.

In conclusion I add that the IBEW finds no further fault with the strict conservation of "on site" energy indicated in the standard's budget levels. We remain in total opposition to any consideration of source energy consumption factors. We are of the strongest opinion that the Building Energy Performance Standards should be in line with the President's National Energy Plan and reflect the clear direction of Congress. The Department of Energy should be confined in rulemaking to aspects of building design and construction rather than compelling selection of energy or fuel types.

**International
Council of
Shopping Centers**

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New York, N.Y. 10022
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June 13, 1980

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*Past President

The Honorable J. Bennett Johnston, Jr.
Chairman
Senate Energy & Natural Resources Committee
Energy Regulation Subcommittee
Dirksen Senate Office Building, Room 3202
Washington, D.C. 20510

Dear Senator Johnston:

The International Council of Shopping Centers Energy Committee is pleased to offer comments on the U.S. Department of Energy's program to establish energy performance standards for new buildings, as defined in Title III of the Energy Conservation and Production Act of 1976 (P.L.94-385). We respectfully request that these comments be made a part of the record of the hearings being conducted by the Energy Regulation Subcommittee on these proposed standards.

The International Council of Shopping Centers (ICSC) is the trade association of the shopping center industry in the United States. The Council has over 8,000 U.S. members and more than 9,600 worldwide. This membership includes individuals and business firms engaged in the daily activity of planning, developing, financing, and operating shopping centers in all fifty states.

Both developers and retail companies are members. The Council is the connecting link between the real estate community and the retail trade industry in the United States. Collectively, members of the ICSC account for upwards of two-thirds of the shopping center space planned, developed and built in the United States each year.

In the interests of scientific inquiry and a reasonable, cost effective building design energy performance standard program, it is requested that the implementation date for the U.S. Department of Energy's proposed regulation on energy performance standards for new buildings be postponed until April 1982.

The ICSC's Energy Committee accepts the premise that shopping center building design influences the amount of energy used in center operations. Building design does have a role to play in overall center energy conservation planning. The potential energy savings implicit in "good" building design, however, is still subject to considerable debate.

In order to make an enlightened contribution to this debate, the ICSC has embarked upon an extensive energy research program with the assistance of Control Data Corporation and the architectural firm of Ballinger, Inc. (Both of Philadelphia, Pennsylvania.) The research is being carried out using actual shopping center engineering and architectural building design data.

The initial objective of the research is to provide a data base for assessing the impact of alternative shopping center design strategies on the building's calculated Design Energy Consumption. Subsequent analysis will concentrate on the relative cost-effectiveness of the design strategies in bringing the building's calculated Design Energy Consumption in line with the U.S. Department of Energy's proposed energy performance standard (the Design Energy Budget) for shopping centers.

In order that the ICSC research results can be tested against the independent findings of existing Federal energy studies, Control Data Corporation and Ballinger, Inc. will use the Department of Energy's DOE-2.1A computer program in all shopping center building design-energy simulation procedures.

However, the assumptions of building functions and operating conditions implicit in the Energy Budget Levels assigned to shopping centers do not conform to actual industrywide practice. To define energy performance standards that are both reasonable to the shopping center industry and acceptable to the Federal government, it is imperative that these assumptions be altered. But to eliminate them without subjecting them to empirical analysis would be equally unacceptable. Therefore, in applying the DOE-2.1A program to the ICSC research data base, the DOE assumptions of building functions and operating conditions will be initially used, tested, and evaluated. Subsequent computer runs will be made using building operating conditions more representative of industrywide practices.

The ICSC research program is currently in the data collection stage. Initial simulation runs will probably take place during late summer. Refining procedures and calibrating the building design model in light of actual energy consumption is scheduled for October 1980.

Evaluation of the data and a summary of the important findings will probably not be available from Control Data Corporation and Ballinger, Inc. until mid-December 1980.

Implementing the Building Energy Performance Standard (BEPS) at the present time will impose considerable costs on the private sector. Only limited technical information is available for easy use by the private developer. One development firm seeking shopping center permits in several areas of the country may require an extensive computer analysis at each location to comply with the review procedure (as now envisioned by local building regulatory agencies).

To reduce the building permit review costs that the shopping center developer will have to incur once the proposed HUD-DOE energy performance regulations are implemented, the ICSC research department is intending that Phase Two of the shopping center energy design study develop information useful for formulating review methods that do not necessitate complex and costly computer runs. More specifically, the research effort will concentrate on perfecting the use of diagrammable manuals in evaluating the energy efficiency levels of alternate shopping center building designs (a) for different parts of the country and (b) for different levels of projected shopping customer densities.

Phase Two of the ICSC shopping center energy design study would probably not be able to begin until January 1981. The basic research approach will be influenced to a considerable extent by the findings of Phase One (which, as previously mentioned, is being undertaken by Control Data Corporation and Ballinger, Inc.) and by the results of Federally-sponsored design studies currently in process.

The analytical portion of Phase Two of the ICSC shopping center energy design study will not be completed until July 1981. Testing the use of the newly formulated manuals on a statistically representative sample of shopping centers will take an additional five to six months of work. Final adjustments prior to general implementation brings the overall ICSC research effort to somewhere around January or February of 1982. Dissemination of the results and training of industry personnel on its use will require an additional six weeks.

The additional time of approximately twenty (20) months should be sufficient for the private sector and the government to perfect the methodology for evaluating the impact of building design on overall energy use in building operations.

It is further recommended that during this period, the Federal government be required to submit a representative sample of new governmentally-owned buildings to an energy design efficiency test, using the U.S. Department of Energy's proposed building energy performance standards and supporting regulation. Such action on the part of government will increase the data base, enabling the performance standards to be adjusted with confidence, where required, and the technical review methodology to be modified with greater scientific precision, where necessary.

In addition, the government should establish training programs for local building regulatory officials to instruct them in the techniques of reviewing the energy design of new buildings. The delay period offers the opportunity for doing this in a non-pressured environment.

We would welcome the government's assistance in our research efforts. We are hoping that during this 20 month period, joint energy design studies can be undertaken by the U.S. Department of Energy, the International Council of Shopping Centers, and other representative trade associations of the real estate industry.

Sincerely,

Howard I. Kalkstein
Director of Research

HIK:ht

NAA NATIONAL APARTMENT ASSOCIATION

STATEMENT OF THE NATIONAL APARTMENT ASSOCIATION BEFORE THE SUBCOMMITTEE ON ENERGY REGULATION , SEANTE COMMITTEE ON ENERGY AND NATURAL RESOURCES IN REGARD TO THE BUILDING ENERGY PERFORMANCE STANDARDS*

June 26, 1980

Mr. Chairman and Members of the Subcommittee:

The National Apartment Association which represents over 45,000 builders owners and managers of multifamily residential housing submits the following testimony concerning the Building Energy Performance Standards (BEPS).

The NAA supports government efforts to encourage energy conservation in multifamily housing as evidenced by its support of legislation such as the Solar and Energy Conservation Bank and energy conservation tax credits. However, we feel that BEPS though well intentioned, will be a costly and ineffective method of encouraging energy conservation.

The NAA supports the two year delay in the deadline for adoption of BEPS provided for in S. 2719, The Housing and Community Development Act of 1980. We recommend that during this delay, a study be undertaken to determine the energy efficiency of buildings built over the last few years. If the study indicates that new buildings are significantly more energy efficient than the buildings used in developing the BEPS standards, then Congress should abolish BEPS.

**The National Apartment Association is an association of over 103 local and state apartment associations whose combined membership includes over 45,000 developers, owners, and managers of rental housing. Its headquarters is located at 1825 K St., NW, Washington, D.C. 20006; and its national officers are: President Rik Fulscher of Denver, Colorado; President-Elect Stanley Taube of Minneapolis, Minnesota; Vice President Robert Esrey of Kansas City, Missouri; Secretary Robert Martin of Dallas, Texas; Treasurer Jack Wood of Marina del Rey, California; NAC National Vice President James Reeder of Fremont, California; and Executive Vice President Ray Olsen of Washington.*

Suite 604 • 1825 K St., N.W. • Washington, D.C. 20006 • (202) 785-5111

STATEMENT OF THE NATIONAL APARTMENT ASSOCIATION BEFORE THE SUBCOMMITTEE ON ENERGY REGULATION (CONTINUED)

June 26, 1980

The data base used to decide the energy budgets is based upon buildings designed in 1975. Since that time, energy costs have increased dramatically, and will continue as deregulation permits U.S. energy costs to reach world levels. Since 1975, the nation has become more energy conscious. We believe a study will show significant improvement in the energy efficiency of newly constructed buildings.

Using free market forces to encourage energy conservation, will save energy without unnecessary government regulation. BEPS is much too complicated and will require that the builder incur additional expenses to obtain expertise (if any is available) to analyze BEPS.

The Council on Wage and Price Stability on behalf of the Regulatory Analysis Review Group issued a report on May 1 suggesting that the Department of Energy and Congress reassess the need for BEPS or at least postpone its effective date. COWPS felt that recent improvements in energy conservation techniques in new construction plus government policies that permit U.S. energy prices to reflect real costs weaken the justification for BEPS.

Admittedly, the Congress, DOE and HUD have spent much time and money on BEPS. We understand the difficulties of abolishing BEPS after so much effort. However, if a study indicates that the energy efficiency of new construction has improved significantly, Congress should abolish BEPS and avoid saddling the apartment and other building industries with unnecessary and costly government regulation.

ASID
American Society of Interior Designers

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June 30, 1980

Dr. Benjamin Cooper
Senate Subcommittee on Energy
  Regulation
Dirkson Senate Office Building
Room 3106
Washington, DC   20510

Dear Dr. Cooper and Members of the Subcommittee:

In anticipation of the continuing Subcommittee hearings on the Building Energy Performance Standards (BEPS) program pursuant to Public Law 94-385, the American Society of Interior Designers (ASID) would like to express its views to be included as a part of the record.

ASID is the nation's largest professional association of interior designers with more than 16,000 members throughout the country. As such, it maintains a leadership role in amplifying the views of the interior designer on legislative matters impacting the design community. The development and implementation of the BEPS program is therefore within the purview of ASID interest and concern.

ASID enthusiastically supports the efforts made by Congress to enact legislation geared toward encouraging energy conservation in building design and construction. The constellation of federal laws, including Public Law 94-385, Public Law 94-163, and similar acts of Congress, represent positive and necessary steps toward conserving our supply of non-renewable energy resources by encouraging conservation considerations in building design. The emphasis on the use of the building energy approach rather than a prescriptive standard is a commendable step toward the attainment of this goal; it stimulates creativity and freedom on the part of the design professional and builder.

As the U.S. Department of Energy (DOE) continues to upgrade the draft standards, ASID recognizes a number of problems and ambiguities which tend to detract from the progress being made in improving energy efficiency in new buildings. Accordingly, ASID would like to voice its concern with a few specific areas which it feels will require additional attention prior to the promulgation of the final standards by the Department of Energy.

NATIONAL HEADQUARTERS   730 FIFTH AVENUE   NEW YORK, NEW YORK 10019   212-586-7111

The Standard Evaluation Technique (SET) and the various computer programs proposed as energy calculation methods are still hindered by technical difficulties and potential inadequacies. For instance, the DOE-2 computer program for simulation of design energy requirements does not have the present capability to simulate most of the heating and air conditioning systems used today. Although capable of simulating central systems, it is unable to handle the unitary commercial and residential systems which comprise the bulk of units sold. In its NOPR and technical support document, DOE indicates the need to expand DOE-2's capability so as to reflect more accurately the current market conditions. Moreover, DOE-2 has the potential for producing user "errors" (or differences) of up to 30% in the calculation of building design energy consumption. A significant amount of "gaming" with the system is possible since many of the inputs call for judgments by the user among a wide range of choices. Further analysis and readjustment of the SET will be necessary before it can function as a reliable and effective tool.

The Design Energy Budgets (DEBs) as they are presently conceived have not been substantiated and are therefore suspect. The DEBs were not established on the basis of any single comprehensive analysis; instead, they were based on a composite of many independent studies. The notable absence of a carefully documented methodology leading up to the selection of the DEBs makes it difficult to verify the accuracy of the numbers. Perhaps it would be possible to measure the proposed budget numbers against the actual metered consumption data of operating buildings. But even this would not open up for inspection the original separate building classifications. Given the uncertain origin of the DEBs and their critical role in the BEPS program, ASID urges that a reassessment of the DEBs' validity be conducted and made available for public review prior to promulgation of the final standards.

The weighting factors, the calculus developed by DOE to account for offsite energy consumption and other variables, is another controversial aspect of the BEPS program. The legal mandate for the establishment of weighting factors is tenuous at best, hinging on an expansive interpretation of the Act rather than an explicit statutory provision. These weighting factors are also dubious from a policy standpoint since they heavily encourage the use of oil and natural gas over electricity. This apparent attempt at developing a national policy of fuel management contradicts other energy policies aimed at reducing dependence on foreign oil supplies, strengthening our balance of payments, and expanding the use of renewable resources such as hydroelectric power. ASID therefore joins the hundreds of other public comments which call for a careful reconsideration of the weighting factors.

Implementation of the BEPS will have significant financial impacts on all segments of the building community. For example, electricity for home heating; a DOE study indicates that electric heating products will drop from about a 34% market share to around 2%. In many instances, the financial repurcussions of the BEPS will be passed on to the consumer. For example, it is currently estimated that cost of compliance with the BEPS for a single-family home will range about $1,500 not including alternate design calculations or increased overhead to builders and design professionals. This figure increases geometrically for larger and more sophisticated building designs. Moreover, added responsibilities of local building departments may be reflected in higher permit costs and inspection fees. In a time marked by inflationary construction costs, volatile interest rates, and a depressed construction market, the interjection of the BEPS program may serve to exacerbate these problems. ASID urges and Subcommittee to investigate the range and scope of these financial impacts and to look at creative alternatives to minimize these impacts.

The financial impacts of the BEPS would be less objectionable if the energy savings promise to be substantial; however, it now appears that the energy savings will be much less than the projected estimates reported to Congress at the time of enactment of Public Law 94-385. With the implementation of the BEPS, energy consumption will only be reduced by about 0.6% during the period of 1980 to 2020, as opposed to the 15% savings which was originally posited. The Report of the Comptroller General to the Congress of the United States on federal legislation intended to make new buildings more energy efficient (January, 1980) concluded that energy savings were questionable at best and fell short of desired goals. Given these more modest projections in energy savings, the larger question comes into focus: could equal or greater energy conservation goals for new buildings be realized for new buildings by other and more cost effective means? ASID reiterates its underlying support for the BEPS, but stresses the need to realize substantial energy savings in the most cost effective and practicable manner.

The goal of maximum energy savings at minimum cost should not be compromised by launching the BEPS implementation program prematurely. The one-year time frame for implementation of the program should be extended to a longer and more realistic time period. In its NOPR of November, 1979, DOE offered only preliminary comments on what its implementation strategy would look like. The details of the program as well as the panoply of technical tools such as a Manual of Recommended Practice and prequalified codes have not yet been published. Further, the massive training effort to familiarize some 20,000 code officials in 12,000 permit-issuing jurisdictions across the country, and to acquaint the several hundred thousand designers, architects, builders, and other members of the building community will require a great deal of time. Preparatory measures such as these are critical to effective implementation of the program, and should not fall prey to an overly ambitious implementation time frame. ASID therefore favors a more realistic implementation time frame of three to five years before Congress considers imposition of the sanction mandated under the Act.

ASID urges the Subcommittee to see that each of these issues is thoroughly addressed before DOE promulgates its final standards in 1981. While ASID remains in support of the BEPS and intends to continue working toward its effective implementation, we urge the Subcommittee and responsible Federal agencies to proceed carefully through the planning stage before embarking on the massive implementation program. Hasty inauguration of any federal program which rides under the banner of energy conservation without actually working as effectively as possible toward that goal could generate unexpected adverse ramifications. ASID hopes that its comments will be useful to the Subcommittee in the course of its continuing hearings on the BEPS legislation.

Respectfully submitted,

Wallace R. Jonason

Wallace R. Jonason, FASID
President

rwd

cc: Linda Jansson, Executive Director

NATIONAL ASSOCIATION OF REALTORS
Ralph W. Pritchard, President
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STATEMENT OF THE NATIONAL ASSOCIATION OF REALTORS®

SUBMITTED TO THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

SUBCOMMITTEE ON ENERGY REGULATION

CONCERNING THE BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

JUNE 5, 1980

The NATIONAL ASSOCIATION OF REALTORS® is comprised of more than 1,800 local boards of REALTORS® located in every state of the Union, the District of Columbia, and Puerto Rico. Combined membership of these boards is over 750,000 persons actively engaged in sales, brokerage, management, counseling, and appraisal of residential, commercial, industrial, recreational and farm real estate. The activities of the Association's membership involve all aspects of the real estate industry, such as mortgage banking, home building, and commercial and residential real estate development, including development, construction and sales of condominiums. The Association has the largest membership of any association in the United States concerned with all facets of the real estate industry. Officers are:

Ralph Pritchard, President, Oak Brook, Illinois;
John R. Wood, First Vice President, Naples, Florida;
James L. Heisel, Treasurer, Harrisburg, Pennsylvania.

The Chief Executive Officer is Jack Carlson, Executive Vice President and Chief Economist; Albert E. Abrahams, Senior Vice President for Government Affairs and Gilbert Thurm, Vice President and Legislative Counsel for Government Affairs.

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SUMMARY OF POSITION

This Association is generally opposed to the pervasive regulation of the housing industry inherent with implementation of the Building Energy Performance Standard (BEPS). We firmly believe this regulation may be obsolete in light of the significant policy shifts and resultant market forces that have come into play since BEPS was authorized by the Energy Conservation and Production Act of 1976. Since this law was enacted government policies have shifted from regulated prices of natural gas and oil, which kept energy prices artificially low and thwarted conservation incentives, to the deregulation of energy prices with accompanying price increases. This shift is providing dramatic market incentives to conserve energy throughout all sectors of our society, including the building sector. We are convinced, based on current trends of increased building energy efficiency, that the market incentives resulting from recent Federal deregulation of energy prices will do the job that BEPS was designed to do four years ago when government pricing policies were subsidizing wasteful energy use. This Association believes the troubled housing industry cannot afford the costs inherent in complying with BEPS, particularly when market forces will promote comparable or superior energy savings. In light of this we now believe the burden of proof of the need for this costly and complex regulation is on the Department of Energy.

If the Federal government is compelled to continue with the development and implementation of BEPS we urge that it be thoroughly tested before it is thrust upon the housing industry. The current implementation timetable will not allow for the testing that is necessary to avoid a potentially costly and disruptive regulatory mistake. Even after being thoroughly tested we urge that BEPS be implemented on a voluntary basis and available to state and local governments for incorporation in their building codes at their option.

BACKGROUND

Our Association is very concerned with the energy efficiency of our nation's housing stock and rightly so in that our membership is involved in approximately 80% of annual home sales. We have been and will continue to be active in legislative, administrative and private industry efforts to ensure greater energy efficiency in buildings. We understand that energy efficient homes are good business, good for the homeowner and good for the nation.

The greatest mechanisms for encouraging energy conservation have been and we feel will continue to be the forces of the free market. Escalating energy prices have forced the housing market like other sectors of our economy to streamline their operations and increase efficiency dramatically. Home buyers are more concerned than ever with the energy efficiency of their new purchase and it is invariably one of the first concerns expressed in the housing transaction. In fact the study commissioned by the Dow Chemical Company during September of 1979 indicates a full 95% of homeowners believed that energy saving features are important in a new home. Furthermore these same respondents believed that the energy saving features in 83% of the cases will add to the resale value of the home. It is very clear the market is responding rather convincingly.

As sellers, brokers and managers of real estate we are very concerned about affordability in the housing market and potential disruptions in the transaction process that could result from imposition of the BEPS standard. We are therefore tailoring our comments to the following areas which we feel are appropriate in light of our role in the housing market: a) Impacts of BEPS on the Affordability of Housing; b) Real Energy Savings of BEPS in Light of Current Industry Efforts; c) BEPS Implementation Issues.

IMPACTS OF BEPS ON THE AFFORDABILITY OF HOUSING

For decades the U.S. Government has fostered the ideal of nearly universal homeownership. The energy performance standard under review today -- although prompted by good intentions -- will serve to seriously undermine this ideal. In fact we believe if implemented across the board this regulation would be the largest single-purpose price increase ever placed on the housing market through Federal regulations. Moreover we believe it will not achieve any more conservation than will occur because of higher fuel prices.

It is clear this nation is in the midst of a housing affordability crisis. This is particularly troublesome in view of population trends which assure us of growing housing demand throughout the 80's. With this continuing upward pressure on the demand side, renewed attention must be focused on creating adequate supplies of housing at affordable prices. We are therefore concerned about any and all governmental actions which impact on the cost of housing.

BEPS is a case in point. Our analysis indicates the front-end compliance costs associated with the proposed standard will have definite and measurable impacts on an individual's ability to enter the housing market. We must determine whether these new additional costs are acceptable and necessary in light of current industry practices which are moving in the direction of significant improvements in residential energy efficiency without Federal mandate or regulation.

Economic Analysis

Inflation has served to benefit those who already own real estate but has created a major obstacle to those who are trying to become homeowners for the first time. Since 1973 the median price for new homes has gone from $32,500 to $62,900, an increase of 94 percent. (See Chart 1) Incomes have not kept up with this pace. In 1973 the median price of new homes was 2.70 times the median family income, but by 1979 new home prices were 3.26 times income. (See Chart 2)

In the last decade inflation hit interest rates as well. In 1973 the average mortgage rate for new homes was 7.95 percent. For 1979 as a whole the average was 11.35 percent and in February 1980 the average mortgage rate was 13.12 percent. Additional action by the Fed to curtail inflation through monetary policy — while deficit spending rolls merrily along — will push rates even higher. Many mortgage lenders have set their rate as high as 17 percent in recent days. (See Chart 3)

Obviously, prices and mortgage rates jointly determine monthly payments. In January 1978 the typical payment for a new home mortgage was $344. One year later typical payments had jumped 25.6 percent reaching $432, and two years later in January of this year the most common monthly principal and interest payment on a new home mortgage was $570, a whopping 65.7 percent higher than January 1978. (See Table 1)

When these monthly payments are compared to monthly incomes the problem of affordability becomes very clear. Principal and interest payment for prevailing rate, 80 percent mortgages on median price new homes required 29.2 percent of median family income in 1979 compared to 19.0 percent in 1973. Current projections for 1980 would produce monthly payments which consume 37.8 percent of expected median family income. (See Chart 4)

These statistics on current conditions and projections portray graphically the environment in which the energy performance standards would be promulgated. Recent statistics compiled by the National Association of Homebuilders using the Department of Energy's prototypical 1176 square foot house suggest a national average materials compliance cost in 1979 dollars of approximately $1500 per home, with some areas of the country facing much higher compliance cost estimates. Throughout the remainder of this analysis we will concentrate on materials costs, but administrative costs can add substantially to this figure, with some small scale homebuilders indicating their costs may double this amount. The $1500 estimate is still too low, however, for two reasons. First, the typical new home size has been increasing each year despite the energy shortgage, with the 1978 median floor space reaching 1,745 square feet. In addition, prices for new residential construction are expected to be 10.5 percent higher in 1980 than they were in 1979. Since prices paid by homebuyers must fully reflect current costs and home size we have adjusted the cost estimates from NAHB upward to $2,500 per home.

Needless to say, a price hike of this magnitude will have significant ramifications on affordability. If we take January 1980 as an example, the median price in that month would have been pushed from $64,400 to $66,900, an increase of 3.9 percent. Under ordinary circumstances this would require an additional $500 downpayment and at the prevailing 13 percent mortgage rate an additional $24 per month for the 30-year term of the mortgage. For 1980 as a whole the impact of higher mortgage rates, higher home prices and the energy performance standard would be extraordinary. The typical monthly payment for the purchase of a median price new home would be $677, a full 38.7 percent of expected monthly income. (See Chart 5)

These price increases in the new home market would undoubtedly cause some prospective buyers to shift their attention from new housing to existing homes. Demographic pressures have already caused existing home prices to jump dramatically. Economic conditions in 1980 and 1981, which will result in nearly a million badly needed new housing units not being built in those years, coupled with production lost due to the price hikes directly related to the BEP standards, will translate into increased demand for existing homes. This will cause further upward pressure on exiting home prices and will serve to keep marginal units in the inventory. In general, these marginal units will not warrant investment to make them energy efficient, but will be seriously deficient from an energy conservation standpoint. Accordingly, these standards — proposed to hasten energy efficiency in the housing stock — would work against that object as well.

In point of fact as we have illustrated we are in the midst of a housing affordability crisis. The implementation of BEP's will further worsen this already serious problem by directly inflating new housing costs by as much as 5 percent in some areas of our nation and by indirectly causing demand-induced price increases in the existing home market. Both increases would be in addition to the 11 percent inflation expected in housing markets this year and the 13 percent price rise forecast for 1981. Furthermore, this inflation would not be restricted to housing. These regulations would add approximately 0.4 percent to consumer price inflation, thereby reducing the purchasing power of the dollar for every household in America. At a time when the government claims to be striving to reduce inflation such action is intolerable.

REAL ENERGY SAVINGS OF THE BEPS STANDARD IN LIGHT OF CURRENT INDUSTRY EFFORTS

The Energy Conservation and Production Act of 1976 mandated the promulgation of the standards we are discussing today. Although only a few years have passed since enactment of that law, these years have been crucial to energy conservation in the residential and commercial sectors. ECPA was being debated in 1975 and 1976, when the housing industry was just beginning to respond to increased energy prices resulting from the 1973 Arab oil embargo. At that time when energy prices were being kept artifically low through Federal policy, it may have seemed logical that government intervention was necessary to expedite those market processes to increase the efficiency of the building sector. Subsequently Federal policy shifted from regulated to deregulated prices thus removing the major obstacle to unrestricted market response to the actual cost of energy.

Great strides have been made and continue to be taken by the industry to increase the thermal performance of homes. For instance we know that the annual adjusted residential energy use growth rate has been reduced from an average of 4.7 percent growth during the period of 1960-1970, to a growth rate of only 2.6 percent during the 1970-1977 period. In addition it is estimated that the typical single family home built today consumes some 30-40 percent less energy than one built in the 1973-1974 period following the oil embargo. A 1977 study by Professional Builders confirms that builders are including energy saving features increasingly. For instance, in the past two years 83 percent have increased attic ceiling insulation, 67 percent have switched to double and triple window glazing, improved weather stripping and have employed various other energy features in their new homes. These findings are underscored by the annual report of the NAHB Research Foundation which highlights increased levels of insulation, greater use of double and triple glazed windows, and increased utilization of innovative heating systems such as heat pumps. Energy conservation packages, which include a number of energy-saving measures, are a common sales tool for new home sellers and buyers are responding enthusiastically.

The Department of Energy estimates that the BEPS standard will save 21-50 percent in the residential sector. However, in that these projections are based on 1975-1976 construction data, we believe these may be lofty estimates at best. The bottom line is that before we implement what is certain to be a costly, complex and potentially disruptive standard, the Federal government should prove it will save a significant amount of energy above and beyond the efficiencies realized as a result of market forces. Current market trends seem to point to the fact that federal regulation in this area may not be desirable or necessary.

BEPS IMPLEMENTATION ISSUES

Currently the timetable for BEPS calls for a final standard to be issued in August of 1980 to be followed by implementation rulemaking. We understand the current timetable calls for implementation of the standard within one year of their final publication. We strongly urge the Congress to extend the Building Energy Performance Standards timetable implementation. In light of the numerous technical problems with the standard which we are aware of combined with the difficult job of promulgating an appropriate implementation strategy, we do not believe that a time span of 16 months will be adequate to thoroughly test the workability of this standard. We believe the Building Energy Performance Standard will only be effective if it is phased in all segments of the building industry on a voluntary basis over a multi-year trial implementation period. For instance, state and local code officials will need time for education, familiarization, and development of techniques to understand and implement the standard. The one year allowed appears to be grossly inadequate. Why rush ahead and risk total collapse of any consensus for this difficult and controversial standard?

Further, we strongly urge the Department of Energy not to request the federal financial assistance sanction offered as an option under the 1976 law when the standard is finalized. This sanction, which must be affirmatively approved by both Houses of Congress before being implemented, is a severe and harsh measure which should not even be contemplated. If imposed, virtually all construction financing would be shut off in the non-complying state. Our experience with this type of sanction under the Federal Flood Insurance Program and the Real Estate Settlements and Procedure Act indicates to us that this rigid, inflexible financing sanction is inappropriate and unresponsive to the diverse housing industry. We are confident that if a workable solid standard is drawn up it will serve as a useful model for state and local governments to include in their codes. A good product should not have to be forced down the throats of state and local units of government nor the building sector.

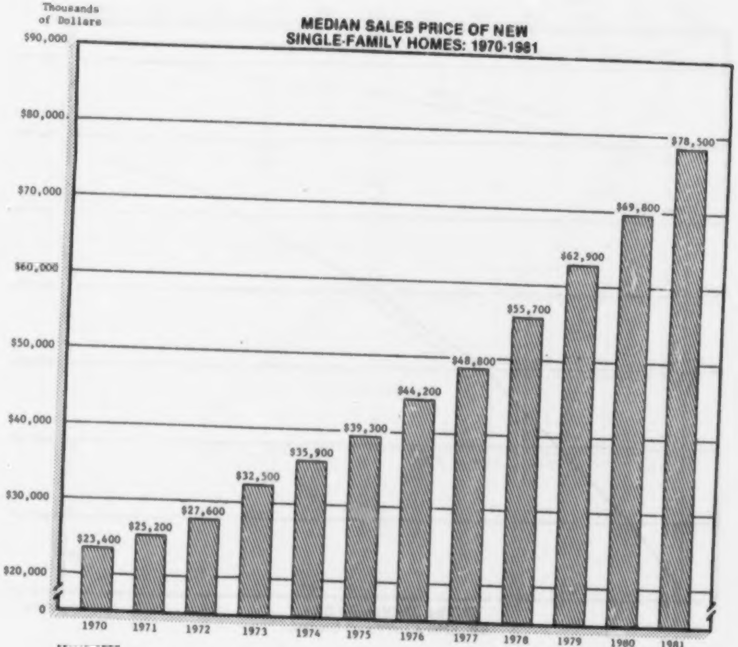
CONCLUSION

In conclusion, the NATIONAL ASSOCIATION OF REALTORS® strongly supports incentives to bring about greater energy efficiency in the new home market. In light of current market realities, it is in the interest of all housing participants to reduce energy costs and streamline energy use in the residential sector.

With respect to the residential sector in particular, the real costs of this standard must be weighed with the affordability of and access to housing by the average American. In addition we strongly believe the implementation timetable should be extended, the expected savings be re-examined, and that the standard be utilized as a voluntary model for state and local use.

We appreciate the opportunity to comment on the Building Energy Performance Standards and look forward to working with members of this committee as your work continues on this and related matters. We strongly urge that no mandatory federally-assisted financing sanction be asked for from the Congress when the final standard is publicized in that it would be very premature and unnecessary at this time. For our part, we will continue to work in both the new and existing housing stock to assist homeowners to make wise housing choices and to increase the energy efficiency of the homes in the marketplace.

CHART 1



March 1980
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CHART 2

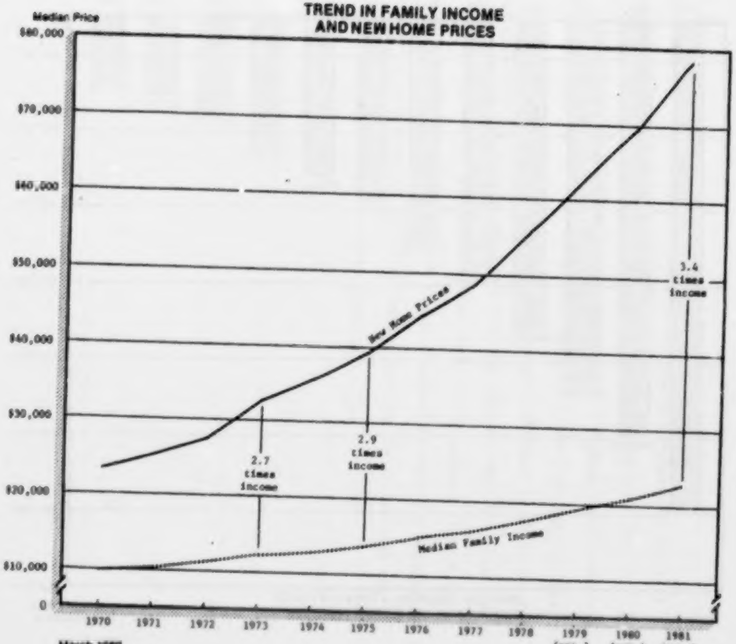

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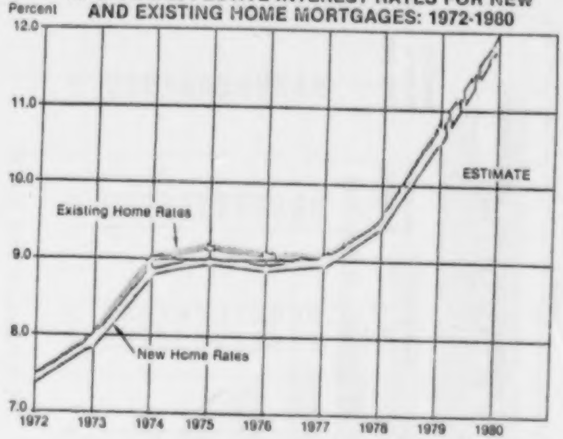
CHART 3

AVERAGE EFFECTIVE INTEREST RATES FOR NEW AND EXISTING HOME MORTGAGES: 1972-1980



January 1980
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TABLE 1

MONTHLY PAYMENTS FOR PRINCIPAL AND INTEREST ON NEW SINGLE-FAMILY HOMES

		Median Price	Mortgage Rate	Monthly Payment	Monthly Payment Year Ago	% Change Year Ago
			80% Mortgage, 30 Year Term			
1979:	Jan	60.3	10.25	432	344	25.6
	Feb	61.2	10.25	439	350	25.4
	Mar	60.4	10.25	433	350	23.7
	Apr	62.6	10.25	449	350	28.3
	May	62.8	10.50	459	367	25.1
	Jun	64.2	10.75	480	382	25.7
	Jul	63.8	10.75	476	368	29.3
	Aug	64.0	11.00	488	386	26.4
	Sep	66.0	11.00	503	393	28.0
	Oct	62.1	11.25	483	400	20.8
	Nov	63.4	11.25	492	404	21.8
	Dec	62.3	11.75	503	420	19.8
1980:	Jan	62.9	13.00	556	432	28.7
			90% Mortgage, 30 Year Term			
1979:	Jan	60.3	10.25	487	387	25.8
	Feb	61.2	10.25	494	394	25.4
	Mar	60.4	10.25	487	394	23.6
	Apr	62.6	10.25	505	395	27.8
	May	62.8	10.50	517	412	25.5
	Jun	64.2	10.75	540	429	25.9
	Jul	63.8	10.75	536	415	29.2
	Aug	64.0	11.00	549	434	26.5
	Sep	66.0	11.00	566	443	27.8
	Oct	62.1	11.25	543	451	20.4
	Nov	63.4	11.25	555	454	22.2
	Dec	62.3	11.75	566	473	19.7
1980:	Jan	62.9	13.00	626	487	28.5

CHART 4

MONTHLY PAYMENTS FOR PRINCIPAL AND INTEREST ON A MEDIAN PRICED NEW HOME

(30 year term; 80 percent loan at prevailing rates)

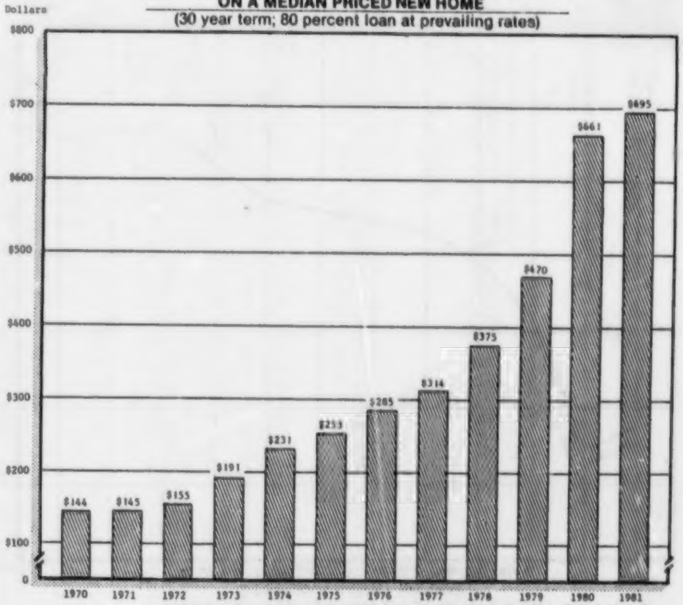

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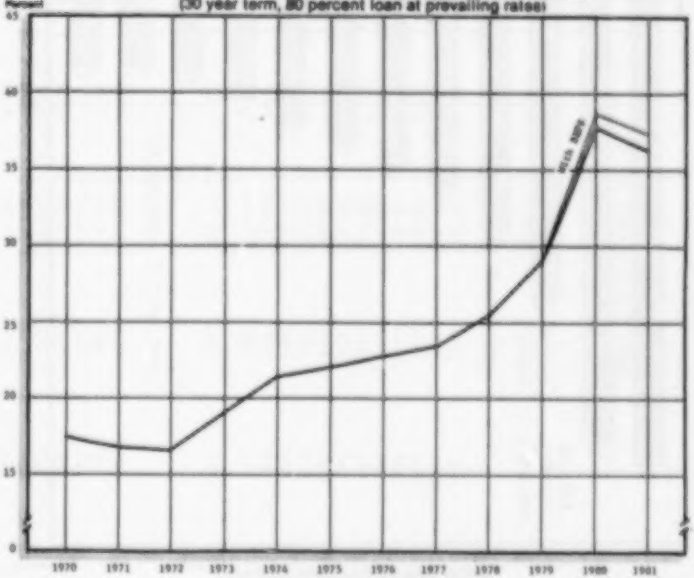
CHART 5

MONTHLY PAYMENTS FOR PRINCIPAL AND INTEREST ON A MEDIAN PRICED NEW HOME AS A PERCENT OF MEDIAN FAMILY INCOME

(30 year term, 80 percent loan at prevailing rates)



March 1980
NATIONAL ASSOCIATION OF REALTORS®

National Forest
Products Association

T. J. Oden
Counsel
Government Affairs

Forest Industries Building • 1619 Massachusetts Avenue, N.W.
Washington, D.C. 20036 • 202/797-5857

June 5, 1980

Senator J. Bennett Johnston
Chairman, Subcommittee on Energy Regulation
Committee on Energy and Natural Resources
U.S. Senate
Washington, D. C. 20510

Dear Mr. Chairman:

This letter is in response to the Subcommittee's hearing on the Department of Energy's Building Energy Performance Standards program.

The National Forest Products Association is a federation of thirty-one associations and agencies and fifteen corporations which collectively represent wood products manufacturing and forest interest throughout the United States. Member product interests include softwood lumber, hardwood lumber, softwood plywood, hardboard, particleboard, hardwood plywood, insulation board sheathing, wood shakes and shingles, wood moldings and wood windows and doors. The major end-use of most of these products is in building construction, particularly residential.

The National Forest Products Association supports the concept of energy performance standards and is working cooperatively with the various federal entities assigned the responsibility of developing effective energy conservation programs for the construction industry. With regard to the BEPS program, however, we do not believe that the proposed standards are sufficiently refined to achieve their intended purpose, either from the standpoint of technical adequacy or enforceability. NFPA, therefore, supports the provision contained in the FY 1981 HUD authorization bills (H.R. 7262 and S.2719) that would extend the promulgation schedule for BEPS for two years. This extension will provide the time required to complete the research and evaluation of the proposed standards and assure a successful program. Precipitous implementation of BEPS at this time would be devastating to the residential construction segment of the economy and contrary to the long-range needs of the public.

In conclusion, NFPA urges your support for a two-year delay of BEPS and requests that this letter together with the attached copy of NFPA's comments to the Department of Energy on this subject be included in the Subcommittee's hearing record.

Sincerely,

T. J. Oden

TJO/oms
Attachment

National Forest
Products Association

Edward G. King, Jr.
Assistant Vice President
Technical Programs

Forest Industries Building • 1519 Massachusetts Avenue, N.W.
Washington, D.C. 20036 • 202/797-5875

April 30, 1980

U. S. Department of Energy
Office of Conservation and Solar Energy
Room 6A034
1000 Independence Avenue
Washington, D. C. 20545

Attention: Joanne Bakos

Gentlemen:

This communication presents comments on the adequacy, applicability and impact of the proposed Energy Performance Standards for New Buildings (BEPS), 10CFR Part 435, as published in the Federal Register, Volume 44, No. 230, November 28, 1979.

The National Forest Products Association is a federation of thirty-one associations and agencies and fifteen corporations which collectively represent wood products manufacturing and forestry interests throughout the United States. Member product interests include softwood lumber, hardwood lumber, softwood plywood, hardboard, particleboard, hardwood plywood, insulation board sheathing, wood shakes and shingles, wood mouldings and wood windows and doors. The major end-use of most of these products is in building construction, particularly residential.

The comments and views given below are based on a review of the proposed ruleand the various Technical Support Documents, and evaluation of the results of forty-one runs with the Standard Evaluation Technique Computer Program (DOE 2.0A). All computer analyses involved single family detached construction. The evaluations were concerned with the rigorousness of the DOE 2 program and the effects of design variables, such as glazing areas, framing effects, attic ventilation, foundation type, infiltration, floor area, roof/wall area ratio, and location.

Our commentary applies specifically to the standards and procedures being proposed for single family detached construction. However, it is believed that most of the observations made also apply to other residential construction types and to commercial construction.

1. Weighting factors. The deficiencies of the proposed weighting factors have been extensively discussed at the

public hearings. We consider the relative market cost of alternative energy sources at the building boundary to be the only equitable and efficient basis for developing energy budgets. National energy policies should be implemented through mechanisms that effect energy market values rather than through arbitrary modification of energy budgets. If the BEPS are to be generally accepted and effectively implemented, regional costs and availability of alternate energy sources must be fully accounted for in the final rule.

2. Standard Evaluation Technique (SET). The proposed standard procedures for determining compliance contain such a large number of ambiguities and gaps that it is impossible to establish whether or not a particular building design is acceptable.

a. Vented unconditioned roof spaces. Neither the SET nor the other support documents indicate how vented attic spaces should or can be analyzed. Can this exterior element be modelled as a single assembly of ceiling, insulation still air space, roof sheathing and roofing, or should it be treated as unconditioned vented space? If the latter, what procedure for estimating air changes per hour is acceptable?

b. Openings. The SET references glazing conductance but makes no reference to whether or not sash and frame material effects should or can be considered. For example, the ASHRAE Handbook of Fundamentals cites significantly different effective U values for windows depending on sash material used and sash design. No indication is given as to whether doors should or should not be considered as separate wall elements, and whether or not differences in thermal transmission properties of doors are expected to be considered. Assuming the opaque areas of exterior doors to have the same thermal properties of opaque wall sections can change design energy consumption by more than 1,000 Btu/sq.ft/yr.

Additional information on treatment of openings is needed.

c. Air infiltration. SET assumes an average air infiltration rate of 0.6 air changes per hour, but establishes no construction guidelines (such as those set forth in FmHA standards) for assuring this level of performance. In view of the fact that a 0.1 change in infiltration rate can change energy consumption 1500 to 4800 Btu/sq.ft/yr (two to six times the effect of changing opaque wall insulation from R11 to R19), this omission appears particularly serious.

Further, SET is unclear as to whether or not energy savings from use of an effective heat exchangerwill be allowed in determining conformance. As heat exchangers can reduce air infiltration heat losses as much as two-thirds and reduce residential energy losses up to 20,000 Btu/sq.ft/yr or more when coupled with tight construction practices, such credit should be specifically provided for and encouraged.

d. Framing. While framing effects (studs, plates, etc.) were included in the establishment of the energy budgets, no guidance is given in SET as to whether this variable should be included as an opaque wall element. The fact that thermal property data for wall and roof assemblies in the DOE 2 library ignore framing effects has suggested to some users that framing effects may be ignored. Considering that treatment of framing sections as separate elements in wall and floor assemblies can change energy consumption as much as 3300 Btu/sq.ft/yr, clarification of the issue in SET is needed.

e. Equipment sizing. The manner in which heating and cooling equipment is to be sized in the system subprogram of DOE 2 is not specified in SET. To the extent that capacities are not sufficient to handle peak or near peak conditions, design energy consumption is reduced. While sizing all equipment to handle heating and cooling peak days would eliminate this variable, such an approach would be unrealistic as far as normal residential construction practice is concerned. Guidelines, such as the maximum number of hours both heating and cooling equipment is allowed to be operating over capacity, should be established.

f. Foundation energy losses. The major deficiency in the SET is the absence of specific procedures for treating ground losses for foundation walls and floors. Depending upon the assumption made regarding foundation floor losses, the energy consumption of houses with conditioned habitable basements can vary as much as 20,000 Btu/sq.ft/yr or 60% of the energy budget. How slab-on-grade losses are modelled also can change consumption values significantly.

For crawl space construction, SET requires that the crawl space temperature be assumed as the midpoint between the design indoor temperature and outside ambient temperature. Based on ASHRAE methods, this is an unduly conservative assumption, even with insulated ducts (see Exhibit A attached).

Specific guidelines or procedures, compatible with the budgets assigned, need to be established for modelling below ground heat losses. Without such procedures, reasonably uniform application of the SET will be impossible to attain.

g. Conformance criteria. Nowhere in the SET is it clearly indicated how close the DEC of a design must be to the DEB to be acceptable. The fact that the budgets are specified to the nearest 100 Btu/sq.ft/yr suggests very close agreement is necessary. Given the modelling limitations, simplifying assumptions, and latitude of input associated with DOE 2, ,such a degree of conformance is unrealistic unless the design energy budgets are based on worst case assumptions, which does not appear to be the case.

Unambiguous criteria should be given in the SET which clearly indicate the acceptable range of a DEC/DEB ratio. The allowable upside range (5%, 10%, 15%, etc.) should be established on the basis of the degree of specificity in the DOE 2 application procedures and the level of refinement in the budgets for each geographical location.

3. Design Energy Budgets. The design budgets for single family residential buildings appear to be inequitable and/or deficient in three aspects.

a. Effect of foundation type. Computer runs with DOE 2 using various modelling assumptions for different foundation types indicates that establishment of a single energy budget for slab-on-grade, partially backfilled first floor, crawl space and unconditioned basement designs would be either extremely restrictive or very inequitable. Basing the budget either on the least energy conserving foundation type in the area, or at least the most common foundation type used in the area (see Exhibit B), is strongly recommended.

b. Establishing energy budgets of regression. Design energy budgets for 68 of the 78 cities covered by BEPS were established from regressions based on the relationship between budgets based on DOE 2 analyses for ten cities and the winter or cooling degree days for those same cities. While correlation coefficients for the regressions are reported to be high, there still is some error associated with the estimate. As a result, some cities will be penalized with more restrictive budgets than others.

Comparison of the DEC's (as determined by DOE 2) for the same house located in a number of different cities with the DEB's for those cities, suggests that in fact the assigned budgets in some locations are more restrictive than those that would be established by conducting a full DOE 2 analysis as was done with the ten base cities.

Budget setting procedures should be established which eliminate this inequity between cities.

c. Size effect. Although the Technical Support Documents indicate no significant size effect on energy consumption, DOE 2 analyses of the size effect on the energy consumption of single family residences in Chicago indicate the contrary. With other variables held constant, including width to length ratio, orientation and glazing area, a 50% decrease in floor area of a single story slab-on-grade house resulted in an 11% increase in energy consumption. This same change in DEC was associated with a 40% increase in wall to floor area ratio and a 20% increase in wall plus roof area to volume ratio. Further, for the same house design, increasing wall height increases design consumption in approximate proportion to the height increase.

Thus, it would appear that houses smaller than the basic design used to establish the budget, or which have a greater wall height than that of the basic design, will have greater difficulty meeting the allowable budget. This inequity, which tends to favor the large house over smaller, lower cost designs, should be corrected either by basing the design budget on a smaller house or establishing budgets for several size classes.

4. Promulgation of Final Rule. Our analysis generally indicates that the proposed rule in its present form is incapable of being uniformly applied or enforced and contains numerous, unjustified inequities involving certain energy sources, locations and particular groups of homebuyers. The few months remaining before scheduled issuance of a final rule appears too short a time to both correct the major deficiencies and develop usable, equitable equivalent component standards.

Further, it is understood that a revised DOE 2 program is to be issued within the next several months. Opportunity for all interested parties to evaluate the new program is needed to avoid future misunderstandings and to identify errors.

At least a one year delay in promulgation of a final rule is strongly recommended to insure an effective usable and enforceable standard is developed which will be generally accepted by building code officials, the construction industry and the homebuying public.

5. Impact on Wood Materials. It appears that DOE has underestimated the impact of the proposed rule on softwood lumber, insulation board sheathing, wood interior finish and wood siding materials.

Although the standards will generate significantly increased demand for 2x6 wall framing material, such framing is not generally available in quantity throughout the country where it would be required. Further, the logs required to produce the wider width framing are in shorter supply than those used for 2x4 framing, and high production 2x4 stud mills are not easily converted to wider width production. Accordingly, the cost of 2x6 framing will be higher on a unit measure basis than DOE appears to have anticipated.

Large quantities of fiber insulation board sheathing presently are used as exterior wall sheathing in residential construction (see page 12, Exhibit F). This material is not mentioned in the Economic Impact Technical Support Document even though its use could be significantly affected by energy budgets requiring use of rigid foam plastic sheathing.

Building code requirements calling for a minimum fifteen minute fire protection interior finish where rigid foam plastic sheathing is used also appears not to have been recognized (see Exhibit G). This requirement eliminates use of hardwood plywood and hardboard interior finish commonly found in recreational rooms, offices and other buildings where the plastic sheathing materials are used.

Of major concern are the performance problems that have developed when certain wood siding products are used over foam plastic sheathing. Cases of excessive shrinkage, splitting and cupping have been reported with Redwood bevel siding and some manufacturers are recommending against use of such siding over plastic sheathing (see Exhibits C and D). Problems with dimpling and waviness in other wood siding products have been reported. The American Plywood Association has special recommendations for installing plywood siding over plastic sheathing and calls for a special warm-side vapor barrier treatment in such applications (see Exhibit E).

The very low moisture permeability of rigid foam plastic sheathing has raised concerns about possible long-term condensation problems caused by these materials acting as cold side vapor barriers. These concerns are based on the general rule that the moisture permeability of the exterior sheathing and siding should be at least five times greater than that of the warm side vapor barrier, a condition not readily met by the plastic sheathings.

The foregoing impacts of the proposed rule on wood products should be referenced in the appropriate Technical Support Documents. To the extent that the final rule provides sufficient latitude for efficient design trade-offs, the impacts cited should not cause major economic hardship nor added cost. Alternatively, the effect of the rule could be very severe in certain areas if the final standards are excessively restrictive and inflexible.

If desired, further information can be provided on any of the issues raised in the commentary, including the results of our applications of the DOE 2 program.

Sincerely,

Edward G. King, Jr.

EGK/oms

National Retail Merchants Association

NRMA

1000 Connecticut Avenue, N.W.
Washington, D.C. 20036
202/223-8250

June 5, 1980
By Hand Delivery

The Honorable Bennett J. Johnston
Committee on Energy and Natural Resources
United States Senate
Washington, DC 20510

Dear Senator Johnston:

I am writing on behalf of the National Retail Merchants Association to submit the enclosed position paper regarding the Building Energy Performance Standard program. NRMA requests that this document be included as part of the record of the Energy Committee's hearings on this matter scheduled for today.

The paper, filed with the Department of Energy on April 30, 1980, deals principally with the November 28, 1979, proposed BEPS rules, and outlines three major retail concerns. First, on pages 6-21, we outline how budget levels and weighting factors selected by DOE will seriously disrupt retail operations. Second, on pages 24-28, we enumerate difficulties posed by the technique DOE has chosen to evaluate building performance. Third and most important from the Congressional viewpoint, on pages 22-23, we explore significant problems which will be encountered if Congress chooses to impose the sanctions included in the Energy Conservation and Production Act.

While the concerns we raise in our paper are serious, NRMA continues to support performance standards for new building construction. We firmly believe performance standards are far more flexible for commercial buildings than are prescriptive standards. Accordingly, we urge you to schedule additional hearings to fully explore the viewpoint of the owners, operators and builders of both commercial and industrial structures.

By way of background, NRMA is a national, nonprofit trade association composed of over 3,500 members operating more than 35,000 department, chain and specialty stores in the general merchandise retail industry. Our members have an aggregate annual

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The Honorable Bennett J. Johnston
June 5, 1980
Page Two

sales volume in excess of $95 billion and employ over 2.5 million workers. In addition, some three-fourths of our members are small businesses, with sales of less than $2 million each.

If you have any questions concerning NRMA or its position on this matter, please feel free to contact me or Ms. Robin Lanier, NRMA Legislative Representative, at 202/223-8250.

Cordially,

Verrick O. French
Senior Vice President
Governmental Affairs

VOF:rms

Enclosure

Plan to attend . . .
7th WORLD CONFERENCE OF RETAILERS and
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COMMENTS

OF THE

NATIONAL RETAIL MERCHANTS ASSOCIATION

ON THE

NOTICE OF PROPOSED RULEMAKING

REGARDING

BUILDING ENERGY PERFORMANCE STANDARDS

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INTRODUCTION/SUMMARY

The following are the comments of the National Retail Merchants Association ("NRMA") on the Notice of Proposed Rulemaking published at 44 Federal Register 68119 (November 28, 1979), concerning energy performance standards for new buildings.

NRMA is a national, nonprofit trade association composed of over 3,500 members operating more than 35,000 department, chain and specialty stores in the general merchandise retail industry. Our members have an aggregate annual sales volume in excess of $95 billion and employ over 2.5 million workers. In addition, some three-fourths of our members are small businesses, with sales of less than $2 million each.

Since 1973 retailing has made great strides in improving building efficiency. We have undertaken numerous investments in conservation principally because energy prices are growing at a phenomenal rate -- two to three times faster than sales. This growth in the costs of doing business exerts tremendous pressure on retail profits which are hard for management to ignore.

Chart I, "Retail Energy Use Trends," dramatically illustrates this direct relationship between increased energy costs and increased conservation, and provides a context within which to view the Building Energy Performance Standards (BEPS) contained in the November 28, 1979, Notice of Proposed Rulemaking (NOPR). For retailing as a whole, Chart I translates into a 30 percent efficiency improvement over 1973 levels for older retail stores. Of equal importance, new stores (not displayed in the chart) are consuming 30 percent less than their most efficient, older counterparts.

NRMA firmly believes that the key to a successful performance standard is understanding these achievements and building on them. Hence, our central conclusion is that improved building efficiency should be achieved by continuing this trend toward improvement, not radical departures from it.

NRMA has consistently endorsed the concept of governmentally required energy performance standards because we recognize the value to the nation of accelerating investment in efficient designs which may be considered economically "marginal." More important, performance standards are far preferable to prescriptive standards as a means to achieve this end.

NRMA is unable, however, to support the BEPS program outlined in the NOPR, despite our past support of the concept of performance standards.[1]

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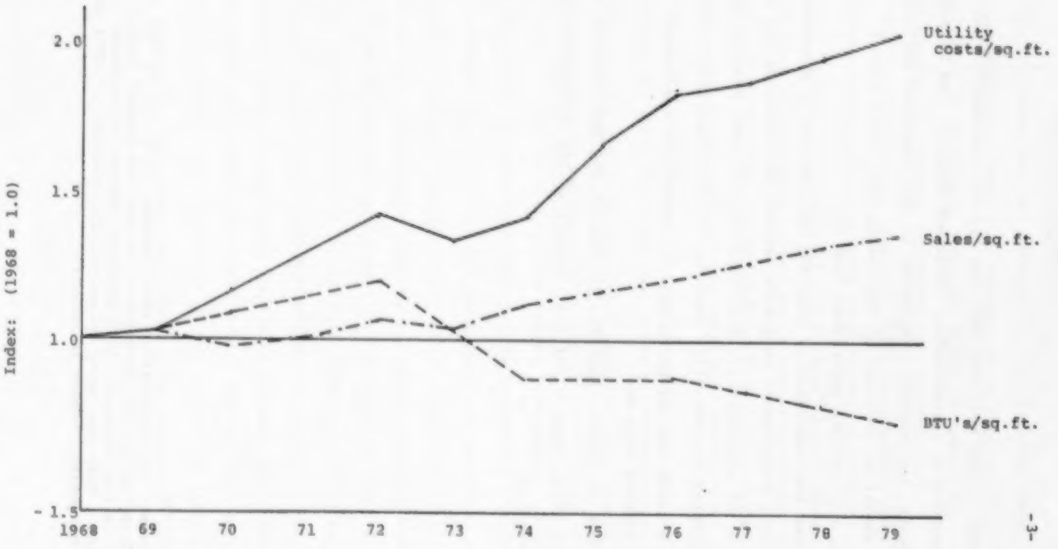
[1] NRMA endorsed the legislation which became Title III of the Energy Conservation and production act and the budget levels included in the November, 1978 Advanced Notice of Proposed Rulemaking. NRMA has never supported the concepts of RUFs and RIFs or Weighting Factors in general.

CHART I

RETAIL ENERGY USE TRENDS*



* Based on figures supplied by NRMA member corporations

Our concerns with the Building Energy Performance Standards (BEPS) fall in three broad categories. First, the budget levels and Weighting Factors are so inconsistent with current trends and practices that they will seriously disrupt retail operations. Second, the sanction which would be imposed on state and local governments for not adopting BEPS is draconian. Moreover, it is imprecisely directed since it adversely affects those required to comply -- i.e., developers -- who may be willing to design and build their building in conformance with the standard and not those who have the authority to adopt or enforce the standard (i.e., states and localities). Finally, significant problems exist with the Standard Evaluation Technique (SET) which should be corrected before the standards are finalized the implementation begins.

NRMA has developed a series of specific recommendations with respect to these three major areas of concern which we believe will vastly improve the BEPS program. It is our hope that DOE will consider these recommendations in detail before final rules are published. Our recommendations are summarized below:

1) Budgets: The energy budgets should be made consistent with current trends. NRMA recommends that DOE make the performance standards consistent with ASHRAE 90-75. This does not mean abandoning performance measures, but simply establishing bugets so that Federal performance standards would be equivalent to performance achievable under ASHRAE 90-75, which has been adopted by 38 states.

NRMA urges DOE to abandon all Weighting Factor approaches. We believe that the "marketplace" provides adequate signals with respect to the "value" of energy resources.

NRMA urges DOE to clarify the definition of process energy for retail buildings, and include the use of display lighting in the definition.

2) Sanctions: NRMA urges DOE and Congress to develop a substitute sanction which permits individuals to comply regardless of whether a state or locality adopts the standard.

3) Timing and Implementation: NRMA urges DOE, with the concurrence of Congress if necessary, to extend the time period for adopting the standards by state and local governments to a minimum of eighteen months to two years after promulgation. NRMA believes that DOE should provide an extensive program to educate both public and private sector officials about the program and its compliance mechanisms. NRMA urges DOE to refrain from making significant revisions in the program for at least three to four years and tie such revisions to changes in the ASHRAE 90-75 standard.

The remainder of our comments explore retailing's concerns in greater depth.

I. THE DESIGN ENERGY BUDGETS

NRMA has three concerns with regard to the Design Energy Budgets for retail buildings included in the 1979 Notice of Proposed Rulemaking (NOPR). First, the budgets are not based on past or present trends in energy conservation. Instead, they represent a major disruption of these trends which cannot be economically justified at this time. Second, the Weighting Factors are unnecessary and heavily penalize those who must use electricity. Third, "process energy" is poorly defined, and ignores many energy uses in retail stores which are related to sales.

The Budgets Represent a Major Break with Current Trends

Table I, "Standards vs. ASHRAE," outlines the relationship among several different performance standards. Column II (ANOPR) represents the standards for a northern and southern store as contained in the 1978 Advanced Notice of Proposed Rulemaking (ANOPR). Column IV (ASHRAE-Equivalent) indicates our estimate of the performance of two stores built in accordance to ASHRAE 90-75 prescriptive standards.[2] Column V (NOPR) represents the budgets in the Proposed Rule. For reference, estimates of energy use in the Phase I data base have been included, along with an estimate of the performance of two 100,000 sq. ft. stores currently in the design phase and scheduled to open in 1981. All standards are given for both a northern and southern store.

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[2] The table is based on information provided by one NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores. The stores are currently in design. All figures are based on interpretations of computer models constructed using EST-I programs, and DOE's Standard Building Operating Conditions and climate information. The cost of this analysis was $10,000.

The table shows two important relationships: First, the jump from the ANOPR to the NOPR (96 to 64 MBTU/sq. ft./yr. in the North and 76 to 58 MBTU/sq. ft./yr. in the South) is extreme, especially since the ANOPR represents a significant improvement over Phase I. Second, buildings built today are already meeting the ANOPR budgets, but not yet meeting the "ASHRAE-equivalent." These same buildings are significantly short of meeting NOPR standards.

This table leads to one major conclusion: The NOPR standards represent a drastic departure from the trend toward increased energy efficiency. Instead, the standards will require building investment which falls much farther from the "margin" than can be economically justified.

When these standards are coupled with Weighting Factors that heavily penalize the use of electricity, they place severe burdens on retailing -- burdens which will impact not only our buildings, but our business plans and the goods and services we provide to our customers.

On the other hand, an "ASHRAE-equivalent" standard would represent a real challenge but also a realistic one. It will serve the intended purpose of the building code envisioned by Congress -- namely, to realize greater energy savings than would be possible by reliance on market forces alone -- while at the same time it would build on, rather than disrupt, current trends in energy conservation.

TABLE I*

STANDARDS VS. ASHRAE

(BUILDING LINE ENERGY)

	PHASE I	ANOPR	CURRENT DESIGNS	ASHRAE-EQUIVALENT	NOPR
NORTH	112	96	90	75	65
SOUTH	94	78	75	67	58

in MBTU/sq. ft./yr.

* The table is based on information provided by one NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores. All figures are based on interpretations of computer models constructed using EST-I programs, and DOE's Standard Building Operating Conditions and climate information.

Moreover, the prescriptive standards mandated under the Energy Policy and Conservation Act of 1975 and the performance standards required by the Energy Conservation and Production Act of 1976 should be made equivalent. The NOPR recognizes this need. However, DOE has taken the particularly sanguine view that prescriptive standards should be made more strict to conform with the Proposed Rule. In so doing, DOE has told the 38 states which have seen fit to adopt ASHRAE 90-75 in response to the Energy Policy and Conservation Act to "go back to the drawing board." Such an about-face in Federal policy only adds to the confusion and uncertainty inherent in planning and building any new structure. NRMA believes that Federal prescriptive codes and performance codes should be merged so that builders have the option of complying with either the prescriptive or performance elements on one uniform standard.

The NOPR Budgets are Based on Faulty Assumptions

The budgets also cannot be justifed on an economic or statistical basis.

The data base upon which the NOPR budgets are based is too small and too biased for DOE to draw any meaningful conclusions about the way retail buildings look and the way they operate. For instance, Phase I data base for retailing consists of only 176 buildings with a substantial range of energy use which runs from a minimum of 25 MBTU/sq. ft./yr. to a maximum of 230 MBTU/sq. ft./yr. The standards themselves are based on only a handful of data points -- the 20 Phase II building redesigns -- extrapolated for both free standing stores and shopping centers.

In addition, the Phase I data were not drawn using true random sampling techniques. Instead, they were drawn exclusively from 37 large Standard Metropolitan Statistical Areas (SMSAs), thereby introducing bias by ignoring a significant number of suburban and small town buildings. Further, 45 percent of the original number surveyed refused to provide information, also introducing bias. DOE further compounded this problem by drawing Phase II data exclusively from the Phase I universe, but only where designers agreed to participate, adding yet a further source of bias. Moreover, the building redesigns were only "paper exercises." NRMA does not believe, therefore, that the building redesigns adequately addressed merchandising concerns.

Similarly, in the Technical Support Document entitled "Economic Analysis," DOE has claimed that stringent standards are more beneficial than lenient standards for both the nation and for individual building owners. For mercantile buildings, this claim is based on a complex life cycle costing (LCC) analysis that calculates net present values (NPVs) of 1.26 and 1.58 for retail investments in increased conservation. On its face, a return of $1.58 per square foot on conservation investments to meet the standards appears quite attractive. However, there are several seriously flawed assumptions in DOE's analysis, any one of which could eliminate this return and actually make it negative.

For instance, the time frame used in DOE's life cycle costing analysis was thirty years -- a reasonable life for the building, but not for HVAC equipment or for lighting systems -- both of which have shorter useful lives. For HVAC systems, useful lives run about fifteen years. As a result, a thirty-year life cycle costing analysis would have to figure the cost of HVAC systems twice. Lighting systems in retail buildings also pose a unique problem because of merchandising concerns. Hence, useful lives are very short for these systems, and must be figured several times in any LCC analysis. Yet, DOE does not appear to have figured the costs of these investments in its analysis.

DOE also failed to recognize the important relationship between reduced lighting levels and sales in retail establishments. Retailers are experts in merchandising, and it is a simple fact of life that well lit merchandise sells better than poorly lit merchandise. The BEPS standard will force retailing to change the way merchandise is lit. The standard could actually force retailing to reduce by half or more the amount of lighting in new mercantile buildings. In our expert opinion, such a reduction will have enormous sales impact. One NRMA member estimates that even a small decline in sales, say one percent for a 100,000 sq. ft. store, could translate into a $1.00 per sq. ft. loss virtually wiping out the NPV calculated by DOE.

NRMA believes DOE has also underestimated the additional construction and design costs that the standard will require. DOE claims that the added cost per square foot of complying with the standards is $1.06. On the other hand, one NRMA member has estimated the costs to be on the order of from $3 to $6 per square foot.

Any one of these items -- failing to include the costs of replacing major systems, lost sales, or greater construction costs -- can significantly reduce or even eliminate the positive NPVs DOE has calculated. Taken together, there is no question that the NOPR budgets are economically unjustified for retailers.

The Weighting Factors are Unnecessary

In addition to its primary goal of improving building efficiency, the Energy Conservation and Production Act contains a secondary purpose -- to discourage the use of nonrenewable energy sources. DOE considered three alternatives to achieve this end: Resource Utilization Factors (RUFs) and Resource Impact Factors (RIFs), Weighting Factors based on the "relative value of different nonrenewable fuels to the nation expressed in terms of fuel prices and explicit national policy determination of non-market values associated with specific fuel types," and reliance on market forces to signal "values."

The ANOPR suggested the use of RUFs and RIFs, which were dropped by DOE in lieu of Weighting Factors based on DOE's 1985 energy price projections with a premium added to oil and natural gas to reflect the extra "value" to the nation of saving these fuels.

NRMA disagrees with DOE's final choice among the alternatives considered. Retailing has consistently taken the position that the only appropriate way to signal the "value" of a resource is through the pricing system. We have consistently advocated pricing energy sources based on the cost of supplying them.

Accordingly, we opposed the RUFs and RIFs approach of the ANOPR, and we are equally opposed to the Weighting Factors included in the NOPR.

We have three concerns with the Weighting Factors. First, they are based on a faulty assumption of how investment decisions are made. Second, they "lock-in" a set of value judgments which are subject to substantial change. Finally, they fail to recognize significant regional and local variations in the value of energy resources.

In Technical Support Document #4,"Weighting Factors," DOE sets forth a rationale for the use of Weighting Factors in lieu of market forces which is invalid. On page 13 of the document, DOE develops a hypothetical case which is supposed to show why "value based" Weighting Factors are needed, and why market forces do not provide designers with the correct signals with respect to nonrenewable fuels. But DOE's argument only works if the notion of "first cost minimization" is accepted without question. Yet, virtually all builders of commercial facilities look farther than first costs. Why? Because it is economical to do so.

Table II, "Conservation Investment Analysis," illustrates just how costly reliance on first costs alone would be for the developer. The first two columns represent the hypothetical case DOE has postulated, where the designer looks at the Investment Cost/MBTU and chooses natural gas over electricity because on a first-cost basis natural gas conservation is half as expensive as electric conservation.

TABLE II

CONSERVATION INVESTMENT ANALYSIS

	Price/ MBTU	Investment Cost/ MBTU	Payback Ratio	Useful Life	12 year		
					Cost	DCF*	NPV
Natural Gas	$ 5	$ 10	2.0	3 yrs.	$ 40	1.34	8.71
Electricity	$ 10	$ 20	1.3	12 yrs.	$ 20	5.18	83.65

* 10 Percent Discount Rate

However, Column III shows how blind acceptance of first cost minimization could result in a designer making investments in gas conservation with only one half the payback of investment in electric conservation. Columns III and IV illustrate how investing in natural gas conservation would actually be twice as expensive, over a twelve-year basis, as investments in electricity. What's more, the return on the investment in electricity is five times greater than the return on the gas investment. Clearly, with large investments of capital involved, builders and developers are going to look at NPVs and discounted cash flow analyses before committing their money. To assume otherwise, as DOE has done, is incorrect and naive.

Thus, a life cycle costing methodology, whether explicit or implied, is in fact used by commercial developers. Under such conditions, owners will make decisions based on the relative prices (both current and projected) of the fuels to be saved, the relative effectiveness of alternative technologies, and the relative size of the necessary capital investments. The result will be conservation efforts which balance these various factors in achieving the best long run result.

The proposed Weighting Factors also establish a current view of the "relative value" of energy resources. As our energy history has more than amply demonstrated, however, the "value" of these resources to the nation and to individuals is subject to substantial change over relatively short periods of time. These changes in "value" are reflected in changing prices. To lock a given set of "values" into the BEPS eliminates the flexibility a building owner ought to have to properly respond as these "values" change. We are all familiar with the perverse effects that control of gas and oil prices have had on our society. To create a similar impediment to our ability to respond to changing circumstances would be foolish and potentially dangerous.

Of equal importance, DOE has chosen to base its "shadow pricing system" on the Energy Information Agency Midrange Energy Forecasting System (MEFS) forecasts for 1985. These forecasts have been notoriously bad, and have changed almost from moment to moment. For instance, in 1978 DOE projected that the price of a barrel of Residual Oil in 1985 would be $24.00. In 1979 they revised that estimate to $27.86. But today, in 1980 we are already paying over $30.00 for the same resource. In addition, DOE has added a premium of $1.29 per million BTU to oil and gas prices, which reflects the additional "value" to the nation of saving these fuels. Yet the Weighting Factors will not lead to the conservation of these resources. They will, in fact, result in additional, uneconomic consumption of natural gas.

Table III, "Weighting Factors Impact, illustrates just how severe the electricity penalty is with respect to retail buildings. The information displayed in the table was provided by an NRMA member undertaking an analysis of two comparable 100,000 sq. ft. stores currently in design. All figures are based on interpretations of the results of computer designs using EST-I programs, and DOE's SBOC and climate input data.

The chart displays the performance of the stores when certain specific conservation measures are taken. The first row ("NOPR") shows the BEPS standards for reference. Row two ("ASHRAE") illustrates the performance of the stores when built to ASHRAE 90-75 standards and using 2.5 wts./sq. ft. of lighting. Row three illustrates what would happen if lights were then reduced to 1.9 wts./sq. ft. Row four displays the buildings' performance if gas conversion was undertaken wherever possible. Finally, rows five and six indicate the budget reductions possible if lighting was further reduced and if changes were made in the roofs of the buildings.

Table III illustrates two important retail concerns. First it directly refutes DOE's claim[3] that the Weighting Factors will not affect buildings able to comply with unweighted budgets. Second, Table III indicates that the Weighting Factors actually encourage the consumption of natural gas wherever possible.

The analysis indicates that the store built in the South and designed to use no more than 1.55 wts./sq. ft. of lighting would comply with the unweighted budget but not with the weighted budget. Even more troubling, if natural gas was not available, a store built in the North would be in the same situation and would still not comply with the weighted budget even if its lighting were further reduced to 1.14 wts./sq. ft.

The magnitude of the change required in lighting levels over current practice is staggering. Most retail stores are not even achieving the 2.5 wts./sq. ft./yr. which an "ASHRAE-equivalent" standard would require. (Most retailers are consuming about 3 wts./sq. ft.) In order to comply with the proposed BEPS, retailers would have to reduce lighting consumption to less than 1.55 wts./sq. ft. -- a reduction of more than half. As discussed above, the effect this would have on sales would be enormous. Moreover, if natural gas is unavailable, it is highly likely that many new retail buildings simply would not be built.

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[3] Notice of Proposed Rulemaking, Energy Performance Standards for New Buildings, November 1979, page 2-39.

TABLE III**

WEIGHTING FACTOR IMPACT

	NORTH		SOUTH	
	Weighted	Unweighted	Weighted	Unweighted
NOPR	158	65	169	58
ASHRAE (L'ts 2.5 wt/sq. ft.)	230	75	205	67
Lights (1.9 wt/sq. ft.)	223	73	191	62
Gas Conversion	171	73	187	62
Lights (1.55 wt/sq. ft.) and Roof	200*/157	64	176	58
Lights (1.14 wt/sq. ft.) and Roof	189*/146	61	166	55

*Natural Gas is not available
Figures expressed in MBTU/sq. ft./yr.

** Information provided by one NRMA member undertaking an analysis on two 100,000 sq. ft. stores currently in design. Numbers are based on interpretations of results of computer models using EST-I programs and DOE's Standard Building Operating Conditions and climate input data.

The table demonstrates quite clearly that in order to comply with weighted budgets, natural gas must be used wherever possible. The Weighting Factors, therefore, actually encourage the use of a "valuable" nonrenewable resource, and discourage the use of energy which may come from hydroelectric, nuclear, or coal-fired utilities.

The vast variety of tastes, locations, and utility systems in this country requires that the BEPS take cognizance of local or regional variations in energy resources. These variations in sources and supply are expressed most readily by variations in energy prices. Rational decision makers respond to these price differentials by designing buildings to meet local conditions. As shown above, the proposed Weighting Factors totally ignore these regional variations. Instead, they force all building owners to respond to a single set of conditions. The result of this approach is clearly damaging for retailing.

In conclusion, NRMA believes that the Weighting Factors are invalid. We, therefore, urge DOE to drop the Weighting Factors from the BEPS standard.

Process Energy is Inadequately Defined

BEPS includes energy used for heating, cooling, domestic hot water, ventilation, exhaust fans and vertical transportation. Energy used for process, equipment and appliances does not appear to be included. Retailing has two concerns with this definition of "process energy."

First, this definition does not adequately recognize the importance display lighting plays in retail establishments. The lighting levels in retail stores are directly related to retail sales. As indicated above, the proposed BEPS coupled with the Weighting Factors would force retailing to significantly reduce lighting levels -- by half or more from current practice -- in new stores. Even if the sales losses were modest -- one percent for instance -- all of the benefits achieved through increased efficiency and reduced operating costs would be lost. There is every reason to believe, however, that the drastic reductions in lighting required by the standard will have much more than "modest" sales effects.

Accordingly, we believe a certain amount of retail lighting should be exempted as process energy. There is a precedent for viewing display lighting differently from regular lighting -- DOE has already made this distinction in its recently published Standby Federal Conservation Plan.[4]

NRMA is also concerned that the definition of process energy does not include store beauty salons, restaurants and automotive repair operations. Clearly, these retail functions should not be included when figuring retail energy budgets. If DOE does intend to include these energy uses, retailers would have no other choice but to consider dropping some or all of these services from store plans and be faced with the attendant economic losses.

The intention of the BEPS program is to improve the efficiency of buildings at a faster rate than would be achieved by market forces alone. However, the BEPS programs outlined in the NOPR goes far beyond this intention. Because the budgets represent a significant break with past and present trends, because the Weighting Factors heavily penalize the use of electricity, and because DOE has failed to recognize the relationship between retailing's use of lighting and sales, the NOPR carries the potential of disrupting the "modus operandi" of all retailers. The proposed BEPS will drastically affect our operations and ultimately the kind of business we do, and in many cases will "force" retailers to reduce future construction, in addition to requiring more efficient buildings.

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[4] 45 Federal Register 8490 (February 7, 1980)

II. SANCTIONS

The Energy Conservation and Production Act includes a sanction which NRMA believes is draconian. The statute requires that no Federal financial assistance may be provided in states or localities that fail to adopt the BEPS program. "Federal financial assistance" is defined to include not only "any form of loan, grant, guarantee, insurance, payment, rebate, subsidy, or any other form of direct or indirect Federal assistance (other than general or special revenue sharing or formula grants made to states)" but also "any loan made or purchased by any bank, savings and loan association, or similar institution subject to regulation by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, or the National Credit Union Administration."

Although only a minority of retail construction projects receive direct or indirect Federal financial assistance, virtually all depend on funding from the second category of sources. The sanction virtually guarantees that all construction would be halted in an affected state or locality. This would happen regardless of whether retailers, the construction industry, and others agreed to comply with the code in the absence of local adoption of it. Thus, the sanction would be imposed on people and business firms who are not able to take the actions necessary to avoid its imposition. While the statute provides for the possibility that the sanction would not be imposed in a state or locality which had failed to adopt the standards (or their equivalent), the alternative depends on the ability (legal and technical) and willingness of a state or local governmental agency to enforce the standards. This seems likely to be useful in only very limited circumstances, i.e., where a state or local government is in the process of enacting the standards but has not done so by the deadline for imposition of the sanctions. Where there has been an affirmative decision not to adopt the standards, an agency is very unlikely to be in a position, legally or practically, to reverse that decision by enforcing the standards under this Federal statutory provision. For the reasons discussed elsewhere in this statement, NRMA believes that many state and local governments will decide not to adopt the program if it remains as now proposed. Thus, we are very concerned that construction would be halted in many areas of the country, whether or not new buildings would actually comply with the standards.

NRMA believes this is unfair. We urge DOE and the Congress to develop a substitute sanction aimed at those who do have the ability to take the necessary actions, and would allow individuals to comply even if a state or locality refused to adopt or enforce the standard.

III. IMPLEMENTATION AND COMPLIANCE

Public Law 94-385 required DOE to develop a Standard Evaluation Technique (SET) to determine whether a specific building design complies with the design energy budgets. The SET is composed of three major elements: an energy calculation method (DOE-II, TRNSYS and DEROB); fixed parameters, such as weather data and Standard Building Operating Conditions (SBOCs) which fix a consistent basis for establishing compliance; and procedures for combining the calculation method with the fixed parameters.

NRMA recognizes the need for establishing a "yardstick" by which to measure compliance. However, we are deeply troubled, as long-time supporters of performance standards, by the complexity of the approach DOE has taken. The SET will undoubtedly lead to misunderstandings, timing difficulties, and a host of essentially technical problems which could doom BEPS from its very inception.

Such a failure of performance-based standards would undoubtedly suggest to Congress and state and local officials that performance standards should be discouraged and prescriptive standards encouraged. This would lead to even greater governmental interference in the design and construction industries, distorting the market and achieving lower levels of energy efficiency.

NRMA has three concerns with regard to the SET. First, the energy calculation method -- the DOE-II program -- is largely untried, and not clearly tied to budgets themselves. Second, because of the size of the data base and problems with the statistical method, the SBOCs are not always representative of the way retail buildlings operate. Third, because process energy is not included and because DOE has chosen a "yardstick approach," the SET will not always predict actual building energy consumption.

DOE has proposed using the computer program, DOE-II, as the principal calculation method of the SET. The most important problem with this approach is that the budgets themselves were developed using a different computer model -- the proprietary AXCESS computer program -- and no study has been made to see how well DOE-II relates to AXCESS. This is especially problematical in light of the apparent difficiencies in the AXCESS program. Because this proprietary program is largely inaccessible, NRMA is unable to comment in-depth on its faults. However, it is common knowledge that the program is incapable of evaluating energy management controls, heat pumps or pipe and duct insulation.

Moreover, DOE-II, based in large part on CAL-ERDA, is untested. It has been used in only a handful of instances to actually analyze new building designs. Its efficacy in predicting energy use for complex designs such as shopping centers is, therefore, unknown. In this light, NRMA believes the program will have to be thoroughly "debugged" before it is ready for use on a daily basis.

As discussed earlier in these comments, serious difficiencies exist in both the Phase I and Phase II data. Yet, these data were used to calculate SBOCs. Obviously, these conditions cannot possibly fit all retail buildings. NRMA is unable to determine if faulty SBOCs will significantly help, or hurt, retailers generally. At least one NRMA member has indicated that SBOCs will cause design changes which will actually increase energy consumption. SBOCs will certainly assure that "design" energy consumption will bear little or no relationship to "actual" energy consumption.

Accordingly, any use of the numbers generated by the SET to review compliance with the program by measuring in-use consumption of buildings designed in compliance with the standards would be disastrous. Retail buildings which comply with the design consumption levels in the standards when compliance is measured using the SBOCs and DOE-II with process energy uses excluded may in actual operation consume significantly more energy than the design levels. So long as everyone understands that the design budgets are fictions based on assumptions and estimation techniques, the program could succeed -- and would, in all probability, achieve energy savings over the status quo. DOE must make this point absolutely clear to enforcing authorities and the general public.

To the extent that DOE fails to make this fiction universally understood, however, there would be a natural inclination by someone wanting to measure the "in-use" success of the program to compare actual consumption levels with the design levels. Such a measurement would suggest that buildings were being constructed in violation of the standards -- of great potential embarrassment to builders and enforcement officials. Similarly, anyone wishing to develop standards for consumption levels of existing buildings would naturally begin with the levels already set for new buildings. Even if modifications to the BEPS levels were made to accommodate the fact that these buildings were designed and constructed when energy was plentiful, the resultant standards would be far out of the range of what would be achievable.

In addition to this concern, NRMA believes that the design and construction professions and the state and local enforcement officials will require a minimum of six months to one year simply to understand the BEPS program -- the budgets themselves as well as the SET. Since no governmental body should be required to adopt and enforce a program which even its most sophisticated personnel do not yet understand, NRMA suggests that DOE, with the concurrence of Congress if necessary, extend the time period for adoption of the standards by state and local government to a minimum of eighteen months to two years after the promulgation of the final Federal regulations. Further, NRMA believes that DOE should provide an extensive program to educate both public and private sector officials about the program and its technical bases.

Because of the need to expand the initial implementation time period, NRMA urges DOE to refrain for at least three to four years from making significant revisions which would either change the way in which the standards are measured or impose more burdensome design consumption levels. Even changes which are supposed to simplify the program should be carefully scrutinized to ensure that they really will do so and that the benefits to be derived from the changes outweigh the costs of re-educating those who will have to live with them. Moreover, any changes made in the standard ought to be tied to changes in the ASHRAE 90-75 program.

Even when the standards are adopted for use by state and local building code authorities, buildings which have already entered the specification phase of design should be exempted from the program. The expense involved in redesigning and changing equipment which may already have been ordered is too great for buildings which have already advanced in the design process. Alternatively, NRMA suggests that buildings not be required to comply with the standards until a set time, perhaps two years after their adoption by the state and local governments. This would accomplish the same purpose without requiring enforcement officials to check company records to determine precisely when specifications were set. Most large retail construction projects are designed two to three years before the facility is open during which it becomes increasingly costly to make significant changes.

IV. RECOMMENDATIONS

The NOPR published at 44 Federal Register 68119 (November 28, 1979) poses many problems to retailing -- the energy budgets represent a major shift from current trends; the Weighting Factors are unneeded and severely penalize the use of electricity; the Sanction included in the Statute is draconian and poorly directed; and the SET is too complex and largely untested in the "real world."

Nonetheless, retailing continues to favor performance standards. We strongly believe that the BEPS program can work. To make it work, however, we believe several changes must be made in the NOPR.

First, DOE should seek to develop design budgets which are equivalent to performance achievable under ASHRAE 90-75. Such a standard will serve the intended purpose of the building code envisioned by Congress -- namely to realize greater energy savings than would occur by reliance on market forces alone. A performance standard comparable to the prescriptive ASHRAE 90-75 standard would be even more stringent than the energy budgets originally proposed by DOE in the 1978 Advance Notice, and it would be achievable.

NRMA opposes Weighting Factors of all types including RUFs and RIFs. Instead, we believe that all budgets should be evaluated in terms of building boundary consumption. NRMA does not believe that the Weighting Factors can be made acceptable through any changes and we recommend they be dropped from the Final Rule.

NRMA also urges DOE to clarify the definition of process energy to exempt beauty salons, automotive repair services, restaurants and display lighting from the design consumption of retail buildings.

NRMA urges DOE and Congress to develop a substitute sanction which permits individuals to be found in compliance regardless of what a state or locality may have done.

NRMA urges DOE to extend the time period for states and local governments to adopt the standards to a minimum of eighteen months to two years after promulgation.

NRMA believes that DOE should provide an extensive program to educate both public and private sector officials about BEPS.

Finally, NRMA urges DOE to refrain from making significant revisions in the BEPS program for at least three to four years and tie such revisions to changes made in the ASHRAE 90-75 standard

The City of New York

WASHINGTON OFFICE

1725 Eye Street, N.W.
Washington, D. C. 20006

202-223-6694

June 17, 1980

Senator Bennett Johnston
Chairman
Subcommittee on Energy Regulation
3202 Dirksen Senate Office Bldg.
Washington, D.C. 20510

Dear Senator Johnston:

On March 13, 1980, the New York City Buildings Commissioner Irwin Fruchtman submitted written comments in response to the proposed Building Energy Performance Standards issued by the Department of Energy. I am pleased to submit these comments to your subcommittee for the record.

Should you or anyone on your staff have further questions with regard to our statement please feel free to contact either myself or Commissioner Irwin Fruchtman at 212-248-8770 in New York City.

Sincerely,

Chris Ann Goddard

Chris Ann Goddard
Legislative Representative
for Mayor Koch
Energy and Environment

The City of New York
DEPARTMENT OF BUILDINGS
EXECUTIVE OFFICES
120 WALL STREET, NEW YORK, N.Y. 10005
IRWIN FRUCHTMAN, P.E. Commissioner
248-8811

March 13, 1980

Ms. Joanne Bakos
Office of Conservation &
Solar Energy
Department of Energy
Docket # CAS-RM-79-112
Mail Station 2221C
20 Massachusetts N.W.
Washington, D.C. 20585

Re: Proposed Energy Performance Standards
in New Buildings, Docket #CAS-RM-79-112

Dear Ms. Bakos:

I appreciate this opportunity to submit my views and comments on the proposed rules relating to energy performance standards for new buildings. While I regret that my staff and I will be unable to testify in person in view of the multitude of other important tasks presently demanding our attention, in addition to the subject proposed rules, I believe it is vital that I make these views known to you and your colleagues, so that your agency may be given the benefit of our input and suggestions.

In reviewing the extensive material that was distributed together with the proposed rules, it appears that the buildings studied country-wide in Phase 2 of your research are unrepresentative of most buildings designed and constructed in New York City. This is regrettable, since the inclusion of such buildings would have highlighted many significant factors that would have obviously been considered by your consultants and colleagues in their preparation of the numerous technical documents, the omission of which represent serious and significant shortcomings in the proposed standards.

The major factors that are typical design and occupancy considerations in the design and construction of buildings in New York City, that would pose a dilemma in application of the proposed standard, to the point, in many cases totally prohibiting construction, are as follows:

1. The fuel weighting factor takes no cognizance of two major sources of fuel which are presently being utilized to a moderate extent, and will probably become more so as time goes on; namely, coal and wood. In addition, virtually all of the borough of Manhattan, south of 96th Street, uses steam furnished by a public utility, whose primary sources of energy are variable. Further, thousands of buildings in this city have now converted to a dual fuel (gas/oil) capability. The methodology in the proposed rule does not at all appear to cope with all of the foregoing.

2. The line of demarcation between "high rise" and "low rise" residential buildings with radically different energy budget levels, is inconsistent with lines of demarcation between different classes of construction specified in the New York City Building Code. This would have the effect of necessitating abrupt demarcations in design methodologies in buildings ordinarily identical in most respects, without any rationale.

3. With all other considerations having limited options, the proposed rules suggests energy savings by reorientation of window openings. In New York City, most developments are rigidly fixed in their orientation, due to densely built-up areas, and zoning high density afforded. Further, in this vein, no specific benefit appears to be afforded designs utilizing party walls with contiguous structures on one or two sides of the building.

4. The mechanical ventilation rates that are permitted before no benefit is gained in calculating the reduced energy level are such that this department feels may pose serious environmental and safety concerns, particularly with respect to carbon monoxide and radon-222 concentrations.

5. The various occupancy factors that go into variation of energy levels, particularly within "commercial" spectrum of uses would run into two major complications with serious legal ramifications.

(a) How is a mixed building, with a significant variation in the multitude of uses listed in the appendix of the rules to be handled; and
(b) Once a building has been designed based on one set of occupancy criteria, may regulatory agencies permit the conversion to another set of uses, which would,if designed for initially, result in a radically different energy budget level.

6. In the past, this department has found that achieving energy conversion levels in component design criteria, insofar as the exterior envelope is concerned, posed a potential serious fire protection problem. It is probable that the energy budget levels established by the proposed rules may have inadvertently reiterated that potential, although unintentionally.

7. At present, variances from local code requirements may be authorized after a public hearing, as warranted, by a Board of Standards & Appeals. There appear to be no provisions in the proposed rules that would authorize this.

I applaud the commendable work done by your department and your consultants. However, I believe the above-mentioned deficiencies and questions should be given serious consideration, and appropriate modifications made.

Based on all of the foregoing, I would suggest that the following conceptual recommendations also be given serious consideration, for inclusion within the proposed rules and/or methodology or application:

(a) The performance approach should be combined with a component guide for small builders, architects and engineers, in order to take advantage of the extensive work and state of the art now existing as a result of promulgation of the State Energy Conservation Construction Codes.

(b) The computer program should be supplemented with other design and calculation programs that can be done by slide rule and simple calculators, particularly for small buildings. This is imperative in view of the potential delays, disproportionate costs and inevitable alternate programs that would be coming on line to meet the same objectives.

(c) As was indicated above, the design of "BEPS" was not geared to the range of building types in dense urban areas where orientation, flexibility and renewable energy sources are not realistic. Since this will represent a large percentage of the total construction in the country, further analysis of this range of buildings and site situations should be made. Additionally, items suggested to achieve the energy budget level such as triple window glazing, etc., should be evaluated from the perspective of keeping costs falling within permissible ranges authorized by HUD.

(d) The New York State Energy Conservation Code, based on ASHRAE 90-75 is now in use throughout New York State, with people trained, both in government and the private sector. New York City will be incorporating said code within our local building code in the very near future; and, it is my belief that many other communities are similar-

It is recommended that such current codes be continued as being acceptable with a comparison with "BEPS" standards required for selected types and numbers of buildings, or HUD funded building, in order to gain experience with actual building with respect to cost, feasibility, etc., with compliance with the new "BEPS" standard to be voluntary for several years. As an alternate consideration, your agency should select as many buildings in this state as you deem appropriate approved under the State Energy Code for analysis and comparisons with "BEPS", with the end result being a sound basis for an equivalency decision.

(e) The fuel weighting factors, which heavily penalize the use of electricity would be an inequitable burden for this city, this state, and the northeast, which has few options at present, and even for the next decade. Moreover, the effect on the environment has not been thoroughly explored, if because of such penalty on site generation is widely opted for. Also the future will, in addition to the comments made above, undoubtedly see other changes in basic fuels used. If the present factors are held firm, there will undoubtedly be an increased use of portable, relatively inefficient plug-in appliances, to circumvent the design penalty for building designs using electricity for building systems requirements.

I hope your agency will give serious consideration to my comments, and take such steps as is warranted to remedy the deficiencies noted by this response. I sincerely appreciate this opportunity to have given you the benefits of our observations and experience.

Additionally, I would like to share with you the comments of Brooklyn Union Gas Co., a major utility, in response to my request for comments from them on "BEPS"

Sincerely,

Irwin Fruchtman, P.E.
Commissioner

cc:
National Inst. of Building
Schience - Thomas Casberg &
Joseph Newman
N.Y.S. Dept. of Energy J. Delaine Jones
N.Y.C. Energy Office, Robert Herzog
N.Y. Officeof Federal/State Relations-M.Godfrey
Deputy Commissioner Minkin
Executive Engineer Polsky
General Counsel Munoz
File

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Brooklyn Union Gas 195 Montague Street Brooklyn, New York 11201 / (212) 643-7790

February 14, 1980

Mr. Irwin Fruchtman, P.E.
Commissioner
DEPARTMENT OF BUILDINGS
120 Wall Street
New York, New York 10005

Dear Mr. Fruchtman:

In response to your letter of December 22, 1979 requesting comments on the DOE's proposed Energy Performance Standards for New Buildings (BEPS), 10 CFR Part 435 the following comments are presented for your consideration:

1. One of the objectives of the proposed law is to encourage the use of solar technology. For solar energy to have an impact, access to sunlight must be made available. Zoning ordinances will have to be enacted guaranteeing solar access and preventing future shading. If these are not forthcoming, incentives to invest in solar technology will be lacking.

   If solar energy is utilized in a building design only to be rendered useless by other construction in the area, litigation could prove costly. Extra staff will be required on the part of the local zoning boards to formulate ordinances guaranteeing solar access and also on the part of the construction industry to ensure that any designs are in compliance with local solar access ordinances.

2. In addition to increasing initial costs, the installation of sophisticated energy management controls to reduce a building's energy consumption will require a more technically competent maintenance staff to service the controls which in turn will increase operating costs. The real problem may turn out to be a shortage of trained personnel thereby negating any energy savings because of malfunctioning controls. The BEPS do not give any credit to user-operated devices to reduce energy consumption thereby encouraging installation of automatic devices.

3. The acceptance of Life-Cycle Cost Analysis will require a retraining or a reshaping of the thinking of constructors and owners who have in the past based their economic evaluations on simple payback. The extra cost of installing energy conserving features to obtain savings in fuel costs which do not return the extra

initial investment within 2 years, even though in the long run a Life Cycle Cost Analysis shows it to be profitable, may discourage construction. A thorough understanding of Life-Cycle Cost Analysis will be required especially in light of the escalating nature of fuel costs.

4. The DOE has indicated that in the future BEPS may include energy credits for ventilation or air infiltration levels below current practice. Studies have been made relating the presence of radon-222 and its decay products with lung cancer. Radon-222 is a radioactive, naturally occurring gaseous element found in building materials. As this element naturally decays its products become airborne. At present levels of ventilation and air infiltration the concentration of these decay products in building air probably does not pose a health threat but may reach toxic concentrations if these levels are reduced. Studies of the above kind should be thoroughly examined before encouraging reduction of ventilation and infiltration levels.

5. In determining the Design Energy Consumption of a proposed building design, DOE recommends the use of the Standard Evaluation Technique and anticipates that the private sector will respond to the need for ready access. This will require personnel support between the DOE and computer service bureaus and between computer service bureau and the designer. From past experience this type of support has been lacking. This could cause delays in starting projects. What evidence is there that this support will be available?

   Will the determination of design energy consumption in accordance with DOE's Standard Evaluation Technique absolve the designer from litigation should operation of the building reveal energy consumption (other than process energy) to be substantially in excess of the design consumption?

6. Congested areas in New York City would not be able to readily utilize solar devices because of limited access to sunlight due to the shading from tall buildings. In residential areas, landscaping installed to protect against the chilling effects on a northern exposure would mitigate solar devices installed on a neighboring southern exposure.

7. In monitoring the progress of the proposed rule elaborate submetering of the components included in the design energy budget will probably be required. If the contractor is obligated to provide this capability in his design, considerable additional expense could be involved.

8. Two problems associated with domestic hot water usage are noted with respect to single family dwellings. One problem is the statement of the budget in BTU/unit/yr.

   Designers seeking credits using solar energy will have less incentive for using solar energy when designing larger houses. The reason for this is seen by noting, for example, that the domestic hot water energy budget level for gas is given as 29,500 MBTU/yr/unit. This amount when divided by the area of the house yields the MBTU/sq.ft./yr. to be credited to the heating and cooling side when hot water is generated by solar energy. As the size of the unit or house increases, the credit allowed on the heating and cooling side will decrease giving the designer a smaller energy budget to work with. Also, for the smaller houses the resulting credit for 100% solar hot water is rather large when compared to the total heating and cooling allotment for single family houses.

   The second problem is the existence of a loophole in applying the domestic hot water credit for using solar energy to the heating and cooling budget. From Appendix 1, any energy form can be selected if the domestic hot water is supplied entirely by solar energy. Because this is a "paper" credit and will be added to the heating and cooling budget, the designer would naturally select the energy source for providing domestic hot water which would yield the largest credit and consequently give him a larger design energy budget. This would be electric at all times. In a 1000 sq. ft. house a 100% solar credit for gas would be 29.5 MBTU/sq.ft/yr and for electric would be 54.5 MBTU/sq.ft./yr. It is realized that the solar would be chosen to replace electric from an economic viewpoint more so than gas because of the higher cost of electric relative to gas. However, this "paper" loophole would be used by anyone choosing 100% solar in order to gain an unfair and extremely high heating and cooling budget.

I hope that the above comments will aid you in analyzing the impact of the proposed performance standards on the construction industry in New York. If further assistance is required, please do not hesitate to call.

Yours truly,

Edwin G. Collins

Edwin G. Collins
Manager
Engineering Department

EGC/RD/dr